### **UNCLASSIFIED**

# AD NUMBER AD833215 **NEW LIMITATION CHANGE** TO Approved for public release, distribution unlimited **FROM** Distribution authorized to U.S. Gov't. agencies and their contractors; Critical Technology; 15 DEC 1954. Other requests shall be referred to Soace and Missile Systems Organiation, Los Angeles, CA. **AUTHORITY** SAMSO USAF ltr, 28 Feb 1972

Analyeis Frepanëd by Chicked by Revised by

CONSCISSATED VILLES ARCIVARY CORPORATIO

PAGE EPORT NO. ZA-7-06-5 MODEL DATE

200 S

4-44les-103

This secument is subject

(5, Special export controls an
each transeach tran

barres of Speckerre. Incredes fore

and Mile Printing Date for

Brownesie Bossie

N. F. Ranig

15 Desember 1954

CONVAIR-

SEP 24 1959

LIBRARY

20060314000

Best Available Copy

----

ANALYSIII PREPARED DY CHECKED BY REVISED BY

21

#### CONSCLIDATED VULTEE AIRCRAFT CORFORATION BAN DIEGO DIVIBION

PAGE 1 REPORT NO. 1.401 103 MODEL 7

DATE 15 DOG. 1954

Curred of Sections. Imperator Even and

Bin Prictica Data for Hyrographic Speeds

1.0

this report proposits curves of shockers, expansion wave and boundary layer data plotted for use at Mach numbers up to 20. Normal and oblique choolisa's parameters, conical shock parameters, expansion wave parameters, come acredynamic coefficients and compressible laniner and turbulent boundary layer skin friction formulas are given for Nach makers up to at least 20. The use of these curves is briefly described in the text.

#### 2.0 Symbols

Co - wave drag coefficient - Have Drag

G: - local akin fristion extitoicat - 3

- perm akin friction overficient = Brys

Cit - north force coefficient - Kirch Force

- coefficient of specific heat at constant presente BRU/16.0R

Cx - smial dres coefficient - avai dres

- accoleration due to gravity

ft./sec.2

heat transfer coefficient

BTU/ft.2nr.ºR

- total presoure

lbs./ft.2

- mechanical equivalent of heat

ft.-1b./870

- thermal conductivity

BTT/ft. hr. OR

- watted length

- effective starting length

- Mach musber

- Faccolt myster v

- statio pressure

1.b./f2.<sup>2</sup>

Pr - Promotel murbon = M.C.

# CONSOLIDATED VULTER AIRCRAFT CORPORATION PAGE 2 EAN DIEGO DIVIDION REPORT NO. A-Atlag-103 MODEL 7

DATE 15 Dec. 1954

•	
Q - heat flux	BTU/hr. ft. <sup>2</sup>
% - dymaio presare	16./ft. <sup>2</sup>
Re - Roynolds meder - pul	100/160
S - reference area	m.2
7 - static temperature	og
7'- reference temperature	°R
72 - Phosecry or inherent temperature	•R
ll - valority	ft./pag.
% - exist length	n.
Management .	
Occasion T	•
$\alpha \sim excls of etteck$	Aegrees
elgan evantección - A	dagraes
V - ratio of specific heat	
d - flow deflection angle, boundary layer thickness	degrees, ft.
8 - boundary layer execution thickness	ft.
Oy - 6323 sazi-verter anglo	degrees
Ow- come shocks are half angle	degrees
11 - coefficient of viscosity	lb. sec./ft.2
7° - Prandtl-Myer angle	degrees
P - Amelty	lb. sec.2/ft.4
T - sheer stress	lbs./ft.2
Pabsoripts —	
•	

- initial or free stream

2 - after the shock

ourface of the com

ste level

PC18.14 (312-A

analvois 1 PREPARED BY CHECKED BY REVISED BY

#### CONSOLIDATED VULTEE AIRCRAFT CORPORATION

BAN DIEGO DIVICION

PAGE 3 REPORT NO. A-Atlas-103 MODEL 7 DATE 15 Dec. 1954

W - at the wall

00 - lessl

¿ - incompressible or lecation index

#### 3.0 Discussion and Results

The need for a combined collection of basic supersonic aerodynamic data has long been evident to Convair Aerodynamicists working with high velocity bodies. The existing charts and tables (Reference 1, 2, 3) are either limited in some phase of Mach number and flow deflection angle or the data are not presented graphically (Reference A). It was believed also that more convenient reference should be provided for the skin friction and heat transfer formulae associated with the reference temperature method explained in Reference 9. This report fulfills these needs.

The sections following will deal with the separate types of curves presented.

#### 3.1 Invisicid Flow Parameters

: The curves in this section are separated into one, two and three dimensional flow. The flow parameters presented, all versus initial Mach number, are Mach number after the shock, static pressure ratio, static temperature ratio, density ratio, velocity ratio, dynamic pressure ratio, Reynolds number ratio, total head ratio and shockave angle. All ratios are quantities after the wave divided by the value of the same quantity before the vave.

Three coefficients are given for both unyawed and yawed cones.  $C_N$ ,  $\frac{dC_N}{dC_N}$  and  $C_N$  are given for cones in Newtonian flow (Reference 4, 5, 6).

The Reynolds numbers presented in Figure 1.6, 2.8 and 3.8 were found from

$$\frac{\mathcal{E}_{22}}{\mathcal{E}_{1}} = \frac{\rho_{2}}{\rho_{1}} \frac{u_{2}}{u_{1}} \left(\frac{T_{1}}{T_{2}}\right)^{0.7}$$

where an exponential viscosity - temperature relation

$$\frac{M_z}{M_I} = \left(\frac{T_z}{T_I}\right)^{0.7}$$

yas assumed.

PAGE 4
REPORT NO. A-Atlas-103
MODEL 7
DATE 15 Dec. 1954

6

The data for these curves were obtained from Reference 1 through Reference 6 or were exaputed for high Mach number-deflection angle combinations when they were not tabulated.

#### 3.2 Viscons Flow Parameters By The Reference Temperature Method

The curves presented in this section are primarily for use with the reference temperature method of calculating heat transfer and skin friction. Figures 4.1 - 4.7 includes local and most incompressible flow skin friction coefficients for laminar, transition and turbulent flow vs. Reynolds number (Reference 7); reference temperature ratio T'/T vs. Mach number; and refrence temperature (T') vs. T'. For use in the heat balance equal the inherent (recovery) temperature rise  $\triangle T_1$  is given versus velocity. The theoretical laminary boundary layer stability curve (Reference 8) is shown in Figure 4.5 to indicate the type of boundary layer flow which might be expected for various H, Tw/T and Re combinations. Figures 4.6 and 4.7 present the MACA-MBS variation of Gp with T and variation of  $\beta$  with T as given by the Sutherland viscosity rule.

The reference temperature method and its associated equations will be presented below in outline form. A complete derivation of these equations may be found in Reference 9, which also contains a critical evaluation of the method. The concept of an "effective length", needed for the application of this method to bodies other than flat plates, is discussed by Sieff (Reference 10) and Romig (Reference 11). Therefore the following sections are primarily on the use of the method in obtaining the heat transfer and skin friction.

The reference temperature method is based on the assumption that the use of a characteristic temperature in the compressible equations for drag and heat transfer will eliminate their outward dependence on temperature and Mach number, i.e., convert them to the incompressible, constant-property equation. Under this assumption the T' method is thus idescribed? as: if all temperature-dependent properties in the incompressible equations for heat transfer and drag are based on the reference temperature T' then the incompressible equations will yield the compressible friction or heat transfer coefficients. Use of this method therefore obviates solving the compressible laminar and turbulent boundary layer equations. The equations for the reference temperature are

$$T' = T_{\infty} \left[ 0.42 + 0.032 M_{\infty}^{2} + 0.58 \frac{T_{\infty}}{T_{\infty}} \right], M \le 5.5$$

$$T' = T_{\infty} \left[ 0.70 + 0.023 M_{\infty}^{2} + 0.58 \frac{T_{\omega}}{T_{\infty}} \right], M \ge 5.5$$
(1)

where the ratio  $T^1/T_{\infty}$  may be found in Figure 4.2 vs. Mach number for integral values of  $1 \leq T_W/T_{\infty} \leq 4$ . The eq. (1) are valid for both laminar and turbulent flow.

₹. Ø

PAGE 5

REPORT NO. A-Atlas-103 MODEL 7

DATE 15 Dec. 1954

#### 3.2.1 Rasic Ernstions for Two-Dimensional Flow

The compressible skin friction may be obtained either as the ratio of compressible to incompressible,  $C_f$  /  $C_f$ :, or explicitly as a function of the Baynolds number based on  $T^1$ . For practical considerations explicit relationships will be developed first for the local and mean compressible friction.

Assume all air properties in the incompressible drag equations are based on f' so that according to the assumption stated in 3.2,

(compressible)  $Cf_{\infty}q_{\infty} \equiv \mathcal{C} \equiv \text{(incompressible)} Cf_{i}q'$ 

where the primes denote that air properties are based on T'.

40

Using the perfect gas squation at constant pressure,

$$\mathcal{L}_{S_{\infty}} = \frac{T_{\infty}}{T'} \mathcal{L}_{S_{\varepsilon}'}$$
 (2)

where Ki is given either by the Blasius formula

LAMINAR 
$$\mathcal{L}_{\mathcal{G}_{i}}' = \frac{0.664}{\sqrt{\rho' u R}}$$
 (3)

or the Karman equation

These laminer and turbulent incompressible friction coefficients (Eq. 3 & 4) are plotted in Figure 4.1 versus Reynolds number. The Reynolds number to be used with Eq. (3) & (4) and hence in evaluating Eq. (2) is a function of T1. The expression for Register as

DATE 15 Dec. 1954

or, using the power law for viscosity,  $\mu \propto (7)^{0.7}$  and using ambient conditions tions as a reference.

$$R_{T'} = \left(\frac{T_{\infty}}{T'}\right)^{1/7} R_{\infty} \tag{5}$$

If the perfect gas law is used and sea level (T = 518.40R) conditions are used in the power lev,

$$R_{e_{\tau}} = 12.44 \times 10^4 \frac{p_{\infty} u_{\infty} l}{(T')^{1/7}}$$
 (6)

Thus it is only necessary to enter Figure 4.1 with  $\mathcal{L}_{e,T'}$ , computed by Eq. (5) or Eq. (6), locate the desired  $\mathcal{L}_{f,C'}$  and compute  $\mathcal{L}_{f,\infty}$  by Eq. (2). For convenience in computing  $\mathcal{L}_{T'}$ , the function  $(T^1)^{1-7}$  is plotted versus T' in Figure 4.3.

The mean skin fristion coefficients may be obtained in much the same way from the drag equation. For both laminar and turbulent flow

$$C_{F_{\infty}} = \frac{T_{\infty}}{T'} C_{F_{L}'} \tag{7}$$

where CF; is given by the Blasius formula

LAMINAR 
$$C_{F_c}' = \frac{1.328}{\sqrt{R_{cT'}}}$$
 (8)

and the Prandtl-Schlicting equation

TURBULENT 
$$C_{F_{2}}' = \frac{0.455}{(log_{10} R_{27})^{2.58}}$$
 (9)

Eqs. (8) and (9) are also plotted versus Reynolds number in Figure 4.1. The same procedure is used in evaluating the mean coefficient as was used for the local.

The compressible heat transfer rate can be obtained from the definition of the heat equation

$$Q = h \left( 7i - 7w \right) \tag{10}$$

#### CONSOLIDATED VULTEE AIRCRAFT CORPORATION

SAN DIEGO LIVISION

PAGE 7 REPORT NO. A-Atles-163 MODEL 7

DATE 15 Dec. 1954

where the heat transfer coefficient is defined as

$$h = \frac{N_u k}{\ell} \tag{11}$$

If the air properties in & are based on T and the following incompressible relationships for Husselt number are used.

LAMINAR 
$$N_{u_n} = 0.33Z \sqrt[6]{P_1} \sqrt{R_{e_T}}$$
 (12)

end

TURBULENT 
$$Nu_{\infty} = 0.0296 \left(R_{T'}\right)^{0.6}$$
 (13)

then after considerable algebraic manipulation the following heat transfer equations are found

CAMBURE 
$$h = 0.0074 \left[\frac{P_0 U_0}{L}\right]^{0.5}$$
 (14)

TERRULAT 
$$f_i = \frac{0.02498 \ (f_0 U_0)}{2^{az} \ (7')^{a.51}}$$
 (15)

It was assumed in Eq. (14) and (15) that the air proporties varied in the following way

$$\frac{\mu}{\mu_{00}} = \left(\frac{T}{T_{00}}\right)^{0.7}, \quad \frac{k}{k_{00}} = \left(\frac{T}{T_{00}}\right)^{0.85}, \quad P_r = 0.72 \neq p = pRT \quad (15a)$$

The validity of Eq. (L) in particular and the exponents in the power laws were substantiated in the investigations of Reference (9). It was found that these heat transfer equations are correct as long as the boundary layer air is not dissociated.

Curves of  $\triangle$  T<sub>1</sub> = T<sub>1</sub> - T<sub>1</sub>, where T<sub>1</sub> is the free stream static temperature, are plotted versus free stream velocity in Figure 4.4a = 4.4c for use in eq. (10).

Thus to compute the compressible laminar or turbulent heat, it is only necessary to find the reference temperature and solve eq. (14) or (15). These values of  $\mathcal{A}$  are used along with the temperatures obtained from Figure 4.4a - 4.4e in eq. (10) to find the heat rate  $\mathcal{Q}$ .

POSM 1818 -

PGHO -812~A

PAGE 8
REPORT NO. A-Atlas-103
MODEL 7
DATE 15 Dec. 1954

#### 3.2.2 Two Dimensional Flow With Discontinuties

The equations (1) - (15) written above apply in strict some only to flat plate flow. Any condition which would tend to make the external flow discontinuous at a point, such as transition from laminar to turbulent flow, or passing through a shockwave or expansion, renders the equations inapplicable.

In order to use eq. (1) - (15) it is necessary, therefore, to sumshow refer the boundary layer characteristics at the point of discontinuity to a flat plate boundary layer with identical characteristics but with no flow discontinuities. This can be accomplished by forcing, as it were, the momentum loss of the boundary layer flow to remain constant across any discontinuity. This momentum-loss method will give an effective starting length for the boundary layer characteristics to the point of discontinuity.

The momentum loss equations are discussed at length in Reference (10) and (11) and only a brief outline of them are given here. If the momentum loss through the boundary layer is defined as

then across any point of discontinuity it is assumed that

$$\int_{0}^{\delta_{1}} \rho u(u_{1}-u) dy = \int_{0}^{\delta_{2}} \rho u(u_{2}-u) dy$$
 (16)

This is equivalent to stating that.

$$\mathcal{O}_{1}g_{1} = \mathcal{O}_{2}g_{2} \tag{17}$$

where  $\Theta$  is the boundary layer nomentum thickness and  $\mathcal E$  the stream dynamic pressure. The laminar or turbulent equations for  $\Theta$  allow (17) to be solved for  $\mathcal L_Z$ , the effective starting length. For convenience in nomenclature  $\mathcal L_Z$  is designated as  $\mathcal L'$  hereafter.

Therefore let

$$\theta_{LAM} = \frac{l_0 328}{\left(\frac{\rho_0 u_0 l}{\mu_0}\right)^{q_2} \left(\frac{C_F}{C_{Fi}}\right)_{LAM}} \tag{18}$$

ANALYSIS
PREPARED BY
CHECKED BY
REVISED BY

#### CONSOLIDATED VULTEE AIRCRAFT CORPORATION

BAN DIEGO DIVIBION

PAGE 9 REPORT NO. <u>A-Atlas-103</u>

MODEL. 7

DATE 15 Dec. 1954

ezd

$$\mathcal{O}_{TURB} = \frac{0.072}{\left(\frac{R_0 U_0 L}{\mu_{00}}\right)} 0.2 \left(\frac{C_F}{C_{F_0}}\right) L \tag{19}$$

where  $\mathcal{L}$  is the length along the body to the point of discontinuity. The turbulent expression for  $\mathcal{S}$  is based on the 1/7th power law for velocity. It is adequate for 5 x 10  $\leq$   $\mathcal{E}$  & 10°. The more exact solution (Eq. (9)) would not be assumble for computation of  $\mathcal{L}'$ . These equations giving  $\mathcal{S}$  can be simplified by making the same assumptions used in the heat equations (14) and (15) in the skin friction derivation to get

$$\left(\frac{CF}{CFi}\right)_{LSM} = \left(\frac{T_{\infty}}{T'}\right)^{0.15} \quad \sharp \left(\frac{CF}{CFi}\right)_{TMS} = \left(\frac{T_{\infty}}{T'}\right)^{0.66} \tag{20}$$

Substitution of (2) into (18) and (19) and use of Eq. (15a) gives

$$\Theta_{LAN} = 0.003765 \left[ \frac{p_{\infty} u_{\infty}}{(T_{\omega})^{1.7}} \right] \left( \frac{T_{\omega}}{T'} \right)^{0.15} \ell^{0.5}$$
 (21)

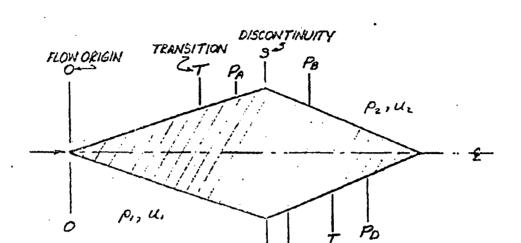
and

$$\theta_{ruzo} = 0.006892 \left[ \frac{p_o u_\infty}{(T_o)^{1.7}} \right]^{-0.2} \left( \frac{T_o}{7'} \right)^{0.66} \ell^{0.6}$$
(22)

These equations can then be used in (17) to obtain  $\mathcal{L}'$ .

Two types of flow discontinuities can be encountered in two dimensional flow. These are (a) transition from laminar to turbulent flow and (b) shockwave or an expension. The equations for  $\mathcal{L}'$  for combinations of these cases are obtained from Eq. (17) - (22) and are summarized in the following table for flow on an infinite double-wedge airfoil, a typical two-dimensional body.

FORM INCH



The following effective starting lengths are given to the points P of interest

70 
$$F_A$$
  $L_A' = TP_A + 0.4696 \left[ \frac{p_1 u_1}{(T_1')^{1/2}} \right]^{-0.375} (\overline{OT})^{0.625}$  (23)

$$TO P_{B} \qquad \mathcal{L}_{B}^{'} = \overline{SP}_{B} + (\overline{SP}_{A} + \mathcal{L}_{A}^{'}) \frac{p_{i}}{p_{z}} \left(\frac{u_{i}}{u_{z}}\right)^{1.5} \left(\frac{T_{z}^{'}}{T_{i}^{'}}\right)^{0.825} \tag{24}$$

To 
$$P_c$$
  $\mathcal{L}'_c = \overline{SP_c} + \overline{OS} \frac{P_c}{P_L} \left(\frac{u_i}{u_L}\right)^3 \left(\frac{T_L}{T_I}\right)^{0.3}$  (25)

To 
$$P_D$$
  $\mathcal{L}_D' = \overline{TP}_D + \left(\mathcal{L}_C' + \overline{P_CT}\right)^{0.625} \cdot 0.4696 \left[\frac{P_L U_L}{(T_L')^{1.7}}\right]^{-0.375}$  (26)

Eq. (23) = (26) may then be used to evaluate the  $\mathcal{L}'$ , which in turn can be used in Eq. (2) = (15) along with local conditions to evaluate the desired coefficients. Since Eq. (1) is independent of length this method does not invalve: iteration:-

## CONSCLIDATED VULTEE AIRCRAFT CORPORATION

MOISTAIN DESIGNATION

PAGE 11
REPORT NO. 4-Atlas-103.
MODEL 7

DATE 15 Dec. 1954

#### 3.2.3 Three Dissocional Flow

Since the boundary layer at any point on a cone is much thimser than the boundary layer of a flat plate which has otherwise the same boundary layer characteristics as the cone, the Eq. (2) - (15) do not apply to conical flow unless some correction is made in order to correlate the boundary layer thicknesses. This correction can be made by working directly with the three-dimensional boundary layer equations in the leminar case. Hantsache and Wessit (Reference 12) found that the conical equations transfermed directly into the two dimensional equations if the factor 1/3 were inscribed in the cone length. Therefore, for laminar flew, if

then Eq. (2) - (15) (with alight modification in the mean friction coefficient) can be used. Van Driest (Reference 13) made the same type of investigation of the three-dimensional turbulent equations and found that the effective starting length for a cone in fully turbulent flow is

Summarised below, for convenience, are eq. (2) - (15) for conical flow. The length used in the actual cone wetted length.

laminar 
$$R_{T_i} = 4.147 \times 10^4 \frac{p_5 \text{ Us } 1}{(T_i^*)^{1.7}}$$
 (29)

turbulent 
$$R_{e_7} = 6.22 \times 10^4 \frac{E_5 \, \text{GL}}{(T_1)^{67}}$$
 (30)

Local skin friction (unchanged)  $\kappa_{f_{\infty}} = \left(\frac{T_{\infty}}{T_{i}}\right) \kappa_{f_{i}}$ 

meen laminar 
$$C_{F_a} = \frac{2}{3} \cot \theta_v \left(\frac{T_a}{T_v}\right) C_{F_c}$$
 (31)

referred to bese area of cone

meen turbulent 
$$C_{F_{\infty}} = 1.02 \text{ cet } \theta_{\nu} \left( \frac{T_{\nu}}{T_{\nu}} \right) C_{F_{\nu}}$$
 (32)

referred to base area of cone (using the 1/5 or 1/7 power law for gives identical results)

$$0.01281$$
laminar  $\mathcal{A} = \frac{0.1281}{0.1281} \left(\frac{p_s u_s}{\ell}\right)^{0.5}$  (33)

PAGE 12

REPORT NO. A-Atlas-103

MODEL 7

and turbulent 
$$h = \frac{0.02866 (p_s u_s)^{0.8}}{(L)^{0.2} (T')^{0.51}}$$
 (34)

Eq. (29) - (34) are then solved in the same nanner as the equations (2) - (15) for two dimensional flow. -

#### 3.2.4 Three Dimensional Flow with Discontinuities

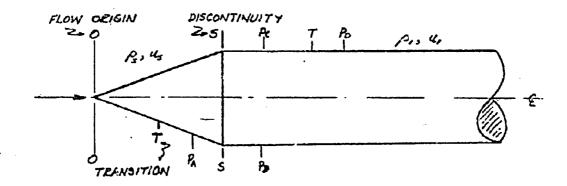
The constant momentum-lost method of section 3.2.2 can be applied to the case of three-dimensional flow. The only changes which need be made are in the equations for the momentum thickness where the factors 1/3 and 1/2 must be inserted in the laminar and turbulent &, respectively. Making this change we have

LAMINAR GLOUR = 0.002174 
$$\left(\frac{p_{z}U_{s}}{(T_{s})^{1.7}}\right)^{-0.5} \left(\frac{T_{s}}{T'}\right)^{0.5}$$
 (35)

TURBULENT 
$$\theta_{cose} = 0.003959 \left(\frac{F_0 \, H_L}{(T_0)^{1/2}}\right)^{-0.2} \left(\frac{T_0}{T_1}\right)^{0.46} \, \ell^{-0.8}$$
 (36)

This sequations are used in Eq. (17) to find  $\mathcal{L}'$  , the effective length, which is then used in Eq. (2) - (15) to obtain friction and heat transfer.

The types of discontinuities usually encountered in conical flow would be found, say, on a cone-cylinder. The equations for various starting lengths found. from Eq. (17), (35) and (36) are summarised for that tody in the following table:



AT 
$$P_A$$
:  $l_A' = \frac{TP_A}{2} + 0.4727 (\overline{OT})^{0.625} \left[ \frac{p_s u_s}{(T_s')^{47}} \right]^{-0.375}$  (37)

AT Pg: 
$$l_{B}' = \overline{SP_{B}} + 0.57435 \left( l_{A}' + \frac{\overline{SP_{A}}}{2} \right) \frac{P_{B}}{P_{C}} \left( \frac{l_{C}}{l_{A}} \right)^{1.5} \left( \frac{T_{C}'}{T_{S}'} \right)^{0.825}$$
 (38)

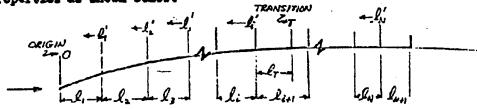
AT 
$$P_c$$
:  $\mathcal{L}'_c = \overline{SP_c} + 0.57735 \quad \frac{\overline{OS}}{3} \quad \frac{P_c}{P_c} \left(\frac{U_S}{U_c}\right)^3 \left(\frac{T_c}{T_S}\right)^{0.3}$  (39)

AT PB: 
$$\ell_p' = \overline{PB} + 0.46.96 \left[\ell_c' + \overline{TPc}\right]^{0.625} \left[\frac{P_c u_i}{(\overline{T_c'})^{1/2}}\right]^{-0.375}$$
 (40)

to be used in Eq. (2) - (15) to find the friction and heat transfer.

#### 3.2.5 Flex Vith Streamine Gradients

In section 3.2.4 the flow on the cylinder portion of the body investigated was assumed to be at constant pressure in order to obtain the simple equations (38), (39) and (40). For the case where a streamvise gradient is to be considered the body must be broken into small segments of constant flow properties. If this is dose then the equations (17), (21) and (22) can be applied to each section and equivalent starting lengths can be found for any point on the body. For flow of such a type consider a numi-infinito biconvex airfoil broken into small segments of constant stream properties as shown below:



DATE 15 Dec. 1954

Each comment has the stream properties p., u; p., u,; p,, u,; ...etc.

To derive the general equation for the effective length slong the body at a point preceded by completely laminar flow, apply Eq. (21) and (22) to Eq. (17). For segment  $\mathcal{L}_i$ ,

50

37

$$\mathcal{L}_{1}' = \mathcal{L}_{1} \left( \frac{P_{1} u_{1}}{P_{1} u_{1}} \right) \left( \frac{T_{1}}{T_{1}} \right)^{2} \left( \frac{T_{1}'}{T_{1}'} \right)^{0.3} \left( \frac{q_{1}}{q_{1}^{2}} \right)^{2}$$

Apply the perfect gas law to the q\_ ratio

and insert in the above equation to get

$$\ell_{i}' = \ell_{i} \left( \frac{p_{i} u_{i}^{2}}{p_{i} u_{i}^{2}} \right)^{2} \left( \frac{p_{i} u_{2}}{p_{i} u_{i}} \right) \left( \frac{T_{i}'}{T_{i}'} \right)^{0.3} \left( \frac{T_{i}}{T_{i}} \right)^{2} \left( \frac{T_{i}}{T_{i}} \right)^{2}.$$

$$cx \qquad \mathcal{L}_{i}' = \mathcal{L}_{i} \frac{p_{i}}{p_{i}} \left(\frac{u_{i}}{u_{i}}\right)^{3} \left(\frac{T_{i}}{T_{i}}\right)^{0.3}$$

This procedure can be repeated for each segment, i.e.,

$$\mathcal{L}_{L}^{I} = \left(\mathcal{L}_{2} + \mathcal{L}_{1}^{I}\right) \frac{h_{L}}{p_{T}} \left(\frac{u_{L}}{u_{S}}\right)^{3} \left(\frac{T_{S}^{I}}{T_{L}^{I}}\right)^{0.3}$$

ůr.

$$\mathcal{L}_{1}^{\prime} = \mathcal{L}_{2} \frac{p_{1}}{p_{3}} \left( \frac{\nu_{1}}{\nu_{2}} \right)^{3} \left( \frac{T_{3}^{\prime}}{T_{1}^{\prime}} \right)^{0.3} + \mathcal{L}_{1} \frac{p_{1}}{p_{3}} \left( \frac{u_{1}}{u_{3}} \right)^{3} \left( \frac{T_{3}^{\prime}}{T_{1}^{\prime}} \right)^{0.3}$$

and in general

$$\mathcal{L}_{i}' = \sum_{k=1}^{k=i} \mathcal{L}_{k} \frac{\dot{P}_{k}}{\dot{P}_{i}} \left(\frac{u_{k}}{u_{i}}\right)^{3} \left(\frac{T_{i}'}{T_{k}'}\right)^{0.3} \tag{41}$$

Let transition eccur at some point T in segment lin at some distance ly from the beginning of the segment. Then the effective length to T is

$$\mathcal{L}'_{T} = \left(\mathcal{L}_{T} + \mathcal{L}'_{i}\right)^{0.625}, 0.4694 \left[\frac{P_{i-1} \mathcal{L}_{i+1}}{\left(\frac{T_{i}}{I_{i+1}}\right)^{1.7}}\right]^{-0.375} \tag{42}$$

and for any general turbulent section thereafter

$$\mathcal{L}_{N}' = \sum_{k=i+1}^{L_{N}} \mathcal{L}_{K} \frac{p_{K}}{p_{N}} \left(\frac{\mathcal{U}_{K}}{\mathcal{U}_{N}}\right)^{LS} \left(\frac{T_{N}'}{T_{K}'}\right)^{0.02S} + \left(\mathcal{L}_{T}' + \mathcal{L}_{i+1} - \mathcal{L}_{T}\right) \frac{p_{i+1}}{p_{N}} \left(\frac{p_{i+1}}{p_{N}}\right)^{LS} \left(\frac{T_{N}'}{T_{i+1}'}\right)^{0.02S}$$
(43)

These generalized formulae for k' may then be used along with local conditions to evaluate the friction and heat transfer at any point from Eq. (2) - (15).

PACE 16

REPORT NO A-4tles-103

MODEL 7

DATE 15 Dec. 1954

#### Leo Conclassions

A collection has been made of acredynamic flow characteristics for one, two and three dimensional hyperscrip flow. The Mach number range is from 0 = M < 20. The flow parameters are shown as functions of initial Mach number and deflection angle in sections 1, 2, 3; Figures 1.0 through 3.16.

Equations for compressible skin friction and heat transfer using the reference temperature method were presented for two and three dimensional flow, flow with discontinuities and flow with streamwise gradient. Figures necessary in using the formulae are in section 4, Figure 4.1 - 4.7.

#### 5.0 Raferences

- 1. Dailey, C. C. and Vood, F. C. "Computation Curves for Compressible Pluid Problems". 1949.
- 2. "Notes and Tables For Use in the Analysis of Supersonic Flow". Staff of the 1 x 3 foot Supersonic Wind Tunnel Section, Ames Aeronautical Laboratory. HACA TH 1428, 1947.
- 3. "Charts and Tables for Analysis of Supersonic Flow". GALCIT Memo #4. Pasadena, 1951.
- 4. Kopal, Z., ed. fables of Supersonic Flow Around Cones. MIT Technical Report No. 1, 1947.
- 5. Grimminger, G., et. al., "Lift on Inclined Bodies of Revolution in Hypersonic Flow". Journal of Aeronautical Sciences, November, 1950.
- 6. Young, G. B. W. and Siska, C. P., "Supersonic Flow Around Cones at Large Yav". RAND Report P-198, March 1951.
- 7. Von Karman, T. "Turbulence and Skin Friction", Journal of Aeronewtical Sciences, January 1934.
- 8. Van Driest, E. R. "Calculation of the Stability of the Laminar Boundary Layer in a Compressible Fluid on a Flat Plate With Heat Transfer", Journal of Aeronautical Sciences, December 1952.
- 9. Rowig, M. F. "The Reference Temperature Method for Calculating Skin Friction and Reat Transfer in Compressible Flow". Convair Memo A-Atlas-151, 3 December 1954.
- 10. Sieff, A. Examination of the Existing Data on the Heat Transfer of Turbulent Boundary Layers at Supersonic Speeds From the Point of View of Repoolds Analogy". MACA TH 3284, August 1954.
- 11. Rowig, M. F. "Survey and Analysis of Experimental Data on Boundary Layer Transition in Supersula Flow". Convair Memo A-Atlas-142, 5 Equantum 1954. (Confidential)

j

12. Hantrache, W. and Wendt, H. "The Leminar Boundary Layer on a Cone in a Supersonic Air Stream at Zero Angle of Attack". Translation RAT-6, RAND Corporation, 1947.

13. Van Driest, E. R. "furbulent Boundary Layar on a Cono in a Supersomic Flow at Zero Angle of Attack". Journal of Aeronautical Sciences, January 1952.

Prepared by: May F. Consider M. F. Roming

H. F. Dumholter

C. 3. Amas

D. Folland

W. Schwidetzky

H. Priedrich

W. P. Edoliffe

L. Jirsa

D. Celling .

H. Stoals

B. Shorey

W. H. Dorrance

Pile

R. J. Elrby

k. C. Enjett

H. F. Roman

R. C. Forell

w. B. Mitchell

W. J. Gendiner

H. Gerbia

F. M. Perkins

C. H. Beaton

P. I. Dinkey

P. E. Culbertson

J. G. Wenzel

G. Noble

8. Banington

J. Farbor

V. Kebely

D. Otis

K. Ehrlohe

MIT (Attn. Security Officer) Copy #31

P. 3. Tip

J. Sherley

R. Wentink

J. Bowyer

H. U. Enkert

W. F. Radoliffo

R-W Library via M. Rosenbaum

Avco Mfg. Co. vin M. Rosenboum

CAN DIESO DIVIDION

PAGE 18

REPORT NO A-Acles-103

MODEL 7

DATE 15 Dac. 1954

#### Index to Figures

#### Section 1. One-Disensional Flow Characteristics

Plotted varsus Initial Mach Bumber

	Figuro	No.	Page					
	1.1	- Nach number after shock	20					
	1.2	- Static pressure ratio	21					
		- Statie temperature ratio	22					
		- Density ratio	23					
		- Volocity and dynamic pressure ratio	24					
		- Raynolds number ratio	25					
		- Total head ratio	26					
		- Area Ratio	27					
Santis	_	The Discontinual Flow Characteristics						

#### A. Commencion

Plotted versus Initial Mach Staber with Wedge Angle a Parameter

Vigura	Ho.	Paga
2.1 2.3 2.4 2.5 2.6 2.7 2.8	- Karimum cono, wedge angles for attached shock - Mach number after shock - Static pressure ratio - Static temperature ratio - Density ratio - Shockwave angle - Velocity ratio - Dynamic pressure ratio - Reynolds number ratio - Total head ratio	28 29 30 31 32 33 34 35 36 37
B. Kan	reside	

2.10a - Mach number versus Prandtl-Meyor angle	\$3
2.10b - Continued	39
2.lla - Static pressure to total head ratio versus	40 to
-2.111 Prandtl-Meyer angle	48

#### Section 3. Conical Ploy

#### A. Flow Characteristics. Unrevel Cone

Platted various Free Stream Much Number with Cone Semi-Vertex Angle a Paramatar

\* U-R=P 1415 - A

# CONDUCTION OF THE PROPERTY CORPORATION

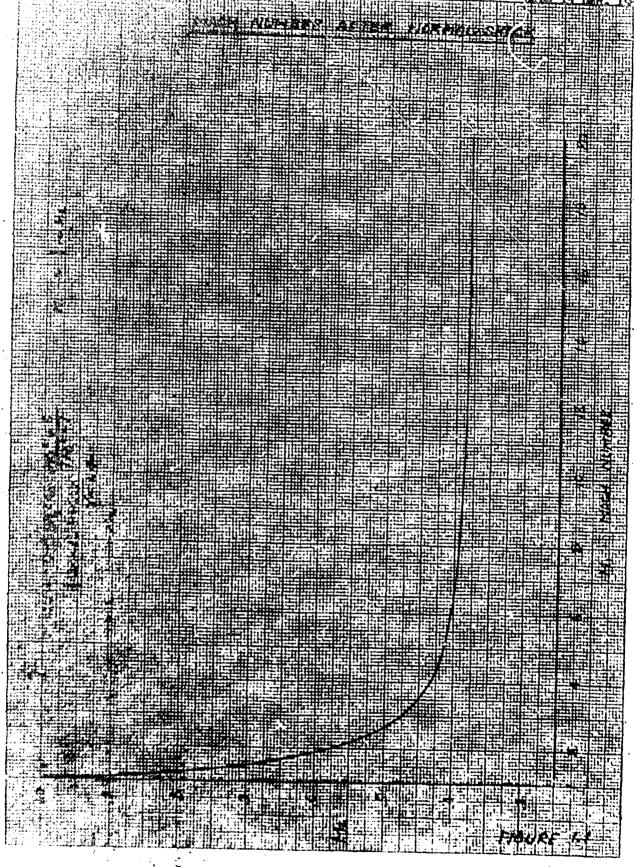
BEECH.

PAGE 19
RESCRI NO A-Atlag=103
MODEL 7

DATE 15 Dac. 1954

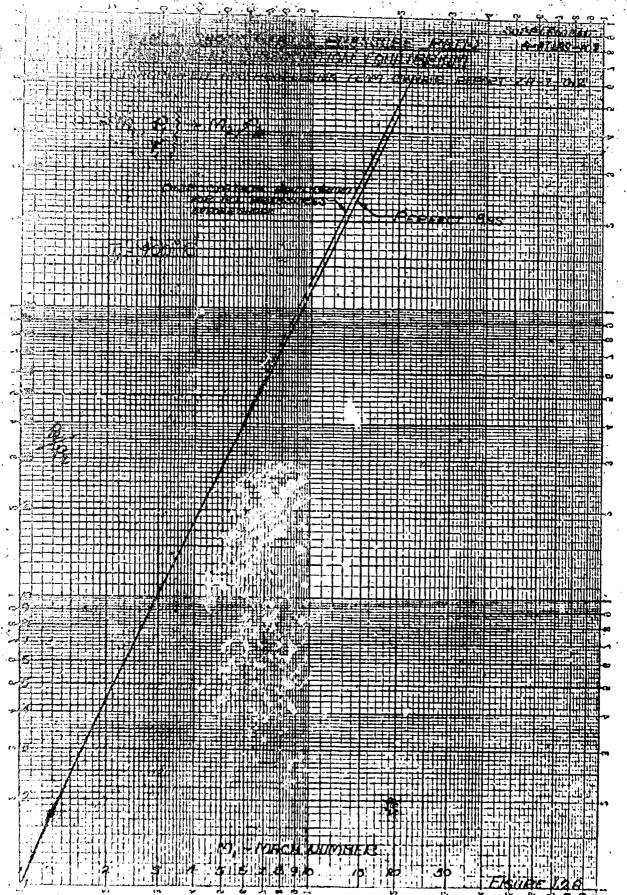
Mewo Is.	Pago
2 % Sample of the land of	
3.1 - Eurfres Kich mader	49
3.2 - Spriaco statio pressure ratio	51
3.3 - Eurface static temperature ratio	52
34 - Eurface density ratio	53
9.5 - Shock wave angle	54
3.6 - Surface velocity ratio	74) EE
3.7 - Surfece dynamic pressure ratio	55 55
3.8 - Surface Reynolds Number ratio	58
30 General Adult Land	577
3.9 - Surface total head ratio	58
B. Force Coefficients. Unversi Cons	·
Elghia Bo.	Pago
3.10a - Vavo drag coefficient versus	59 to
-3.10d Cone half-engle	
	62
3.11 - Initial Axial Force coefficient,	• •
Ckaro /sin 20v vorsus Mach member	63
3.12 - Tritial mormal force coefficient alops,	
(dCu/du) (00 /cs20v , vo. Hack number	64
C. Farca Coefficients. Yevel Cons	
Pigure Eo.	Pago
3.13 - Additional axial force coefficient due to	•
angle of attack/ of versus Mach number	65
3.14 - Mormal force coeffici nt/cm + 0v versus	
angle of attack (Newtonian Flow)	<b>6</b> 6
3-15 - Kurral ferce coefficient alope/con201	
versus angle of attack (Newtonian Flow)	67
9.16 - Axial force coefficient varsus angle of	01
attack (Newtonian Flow)	68
general (mendournal 1104)	68
oreion 4. Viecous New Phantiers	•
Figure Eo.	Po go
4.1 - Incompressible laminar and turbulent mean and	
local skin friction coefficients versus	
Bereelds number	<b>6</b> 9
4.2 - T'/? versus Mach sumber	70
and the same of th	70 71
4.3 - (2) 11.7 mems 21	17
4.3 - (1')1.7 verms 1'	
4.44 - 4.40 - Inherent Amperature rise. ATi, versus	
4.44 - A.40 - Inherent Amperature rise, ATI, versus velocity	72 - 74
4.44 - A.40 - Inherent Adaptrature rise, ATI, varsus valuality  A.6 - Specific heat of all varsus temperature	72 - 74
4.44 - A.40 - Inherent Adaptrature rise, ATI, varsus valuality  A.6 - Specific heat of all varsus temperature	72 - 74 77
4.44 - A.40 - Inherent Amperature rise, ATI, varsus validity  A.6 - Specific heat. of air versus temperature  4.6 - Minister writtent Enysolds number for stability	72 - 74 73 76
4.44 - A.40 - Inherent Adaptrature rise, ATI, varsus valuality  A.6 - Specific heat of all varsus temperature	<b>7</b> 7

严禁不知 经外价一次



E A

Page 21
Report No. A-Atlac-103 MACH LUMBER 17. Ξi. FIGURE Marin Marin



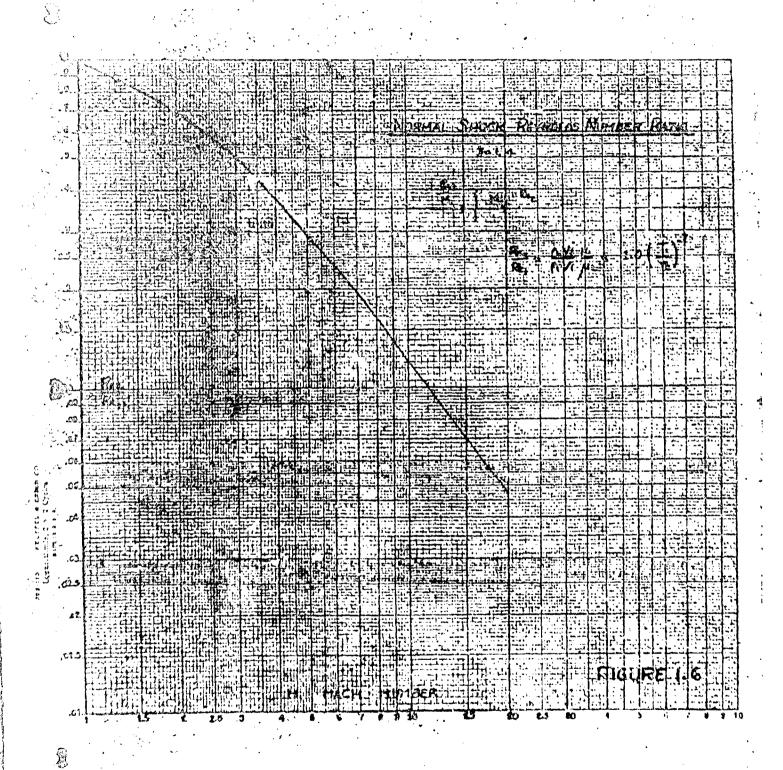
W.

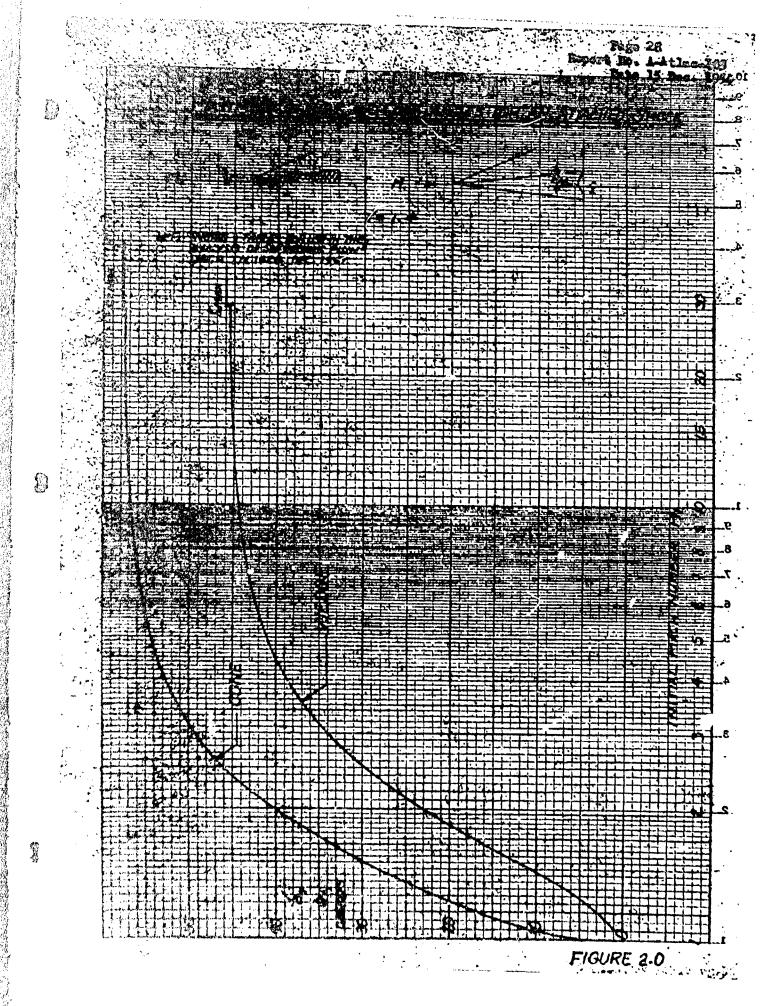
K-K KENMET WERES CO STREET TO THE STREET

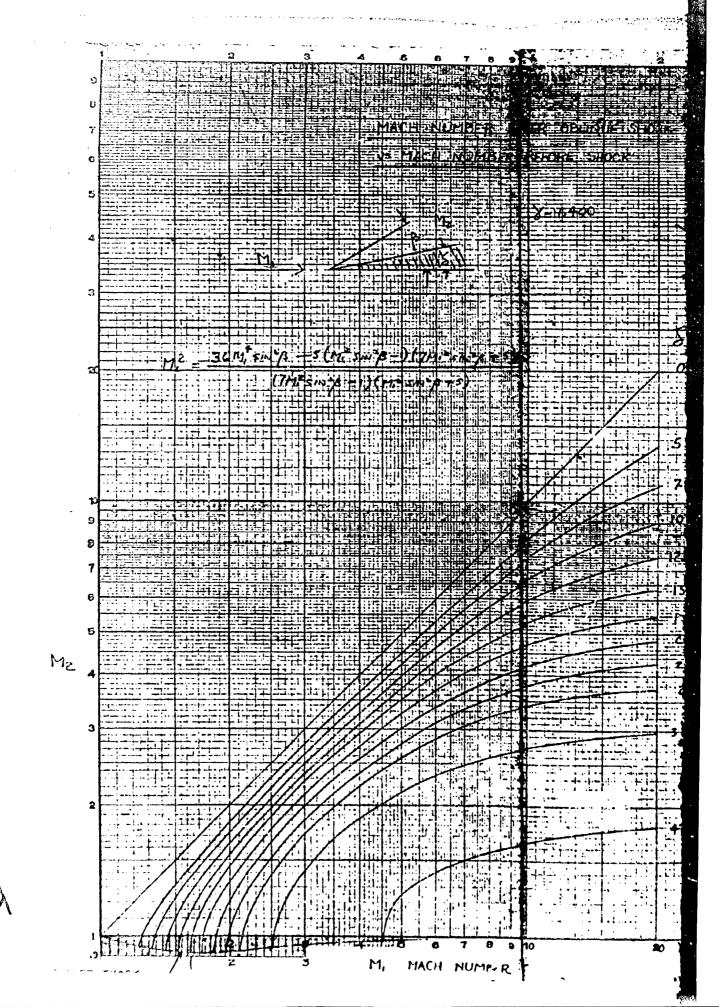
			. • •					*		<u> </u>   .	-	<u> </u>				1		- 1; -   - 1			SIL	<i>ו</i> ס	-w	EAL	<b>f</b> :	- [
			- 1		:	ļ	:::	1		<u> </u>		<u> </u>					1	:	Ϊ.	:		9-0	T .	7.C	100	, [
		: 	* *		::::::	-¦-:	<u>!</u>	1				!	1	:	-	1		1	1		• .	4-62			1	Ī
				.   			į.							!	-	1	.  .	1	-				<b></b> -	<del> </del>	ļ	~.
			12:	1:	11/	ÓΕ	W)	01	٠. ر	54	100	V	7	رعاد	110	7		5	;—. 37		+	<del> </del>	<del> </del>	<del>                                     </del>	-	
	: 1	:: ·		1-1	10		1/4	1	$\frac{1}{2}$	1	1/5		14		10 10	<u> </u>	<del>} -</del>	经	4/_	<u>/U</u>	1	<u> </u>	ļ	ļ	ļ	- : -
			1		1	1.6.6	<u> </u>	<u>د</u>	77.	14	110	$\frac{\alpha}{\alpha}$	d Sal	EL	KI	AV	4-4	P	411	II	五个	111	<u>(V)</u>	<u>: : :</u>	<u> </u>	-
			1	·	1	ASC		TEI	7 4	91E	2	eo.	PΕλ	371	ës _	FRY	M.	.cc	ÌΨ	igne	P	EEC	EI.	Z	b-7	) }-
			<u> </u>		<del>    -  </del>	1		-		-	P,	-	8-×	182			1: ·	<u> </u>	_	<u>:</u>	1	!				:
;	••••;		-	-		-	1	ļ.,	ļ 	ļ	1		<u> </u>	P	<u>.</u>			<u> </u> -	ļ	<u> </u>	::	-				
· - ‡	;	·····		-	1	į		ļ			1	<u> </u>		:	]::::	: :-	· ·						:	Ī -		
			-	!	17	4	bo.	P			1		ļ. :				1			1::.	1	1.	1	<del> </del> -	_	<u>:</u>
	- 1					<u> </u>		:		.	:-::		: -;				1	· .					ļ	-	 	-1 <del>-</del>
		• • •			1				-	Ī ·		. :	1			1:::	·	<u> </u>			<del>                                     </del>	<del> </del>				+
				1			1	ļ.	-		-				1::::		<del></del>	<u> </u>	-						ļ- ·	÷
	. !			1		<u> </u>	-	<u> </u>		-	1		-		1	<u> </u>	<u> </u>	<u> </u>			<del>  -</del>					
	- ;			j -			<del> -</del> -				<u> </u>				-				_	<del>;</del>	<u> </u>	<u> </u>			ļ	:
		ප		-		1				<u> </u>			-					-		<u>'</u> :						:
	<u>.</u>			ļ		ļ:						····		1	<u>  : :  </u>	:	:::	:::							ii	i •
<u>, i., j.</u>				::-										. :				į				:				:
			-::	-	: .												• • •		: :::-	:::		1			PA	r
		15	•	· ·	<u>  : : :</u>	:		.:-	. !			.;•			!									フ	.0	ò
<u> </u> L				<u>.</u> .			J .		.: '	::				•			:::::	1,11			:					-
					:	• . :.	:::		: . į	;	: . <u> </u>	: ::	j	: :		:	:			<del> </del>				爿	0	t
Ŕ	. !			1	-				.				-:::	•		:::.						-				! 
3	1											-			<u>.</u> :			$\rightarrow \downarrow$	•••	<del>-</del>	<u> </u>	<del> </del>				-
र्	<i>y</i>	12		1.										. : : :			إسميم	-			أسند	=	-	$\dashv$	10	<b>)</b> -
3		-											!	ا:	أسمر	·	اسميز	لمنه	سبب		النست	-			<b>i</b>	<u>.</u>
زيد									<u> </u>				الر-:			لخسر		_								_
7		- :					[		‡			ار ــا		أسر	أسنن										1	
		9						· .	٠ ــ ٠					$\leq$							. [		. ;	-	ľ	
इंग्रे							- !	<u>.</u>		ا		-			1	[			;		į					-
		_	:		. '		· :				<b>//</b> :			-	!			-:[			. 1	T		- 60	·	•
•		-		;			•	لمبير	dis		i	-			1	1			26	0.5		G		T	<del></del> -	-
i	<u>ک</u> نو :	2				لمسمر	· · · · · ·	-		Ì	1	Ī	i						م.مـــــــــــــــــــــــــــــــــــ		. <b></b>	ماد.	<b>~⊒;.</b> .			
				•		-:-!				1		1	:	1			1	_	<del>-                                    </del>		<u>i</u>					-
1	<b>-2</b> 5/1.			1				i			: !	Ţ.		1		7 -		-;- -			*****		٠٠٠٠		<u>.</u> .	••
:				/-		;				i			:	·i		-			<u>-</u> .	‡				- <u>i</u> -		
. :			•	•		٠.		•			:	ī	. !		• -,	- }-	· • ·		_i	!				]	;	
	ť	9 !		in			~ ~	- 4.	14.,			;	•	i			e e spetagen.		** #\#	ļ.	LIVATA PAG	i.	** ; ···		bar, ana.	
		0				1		-		<b>(3</b> )				1		:		76	!	į		EO				
		:						(`	7.	-:h	NAC.	11	ARU	ri) i	ar.	5 <sup> </sup>				,						

S

B







Page 29 Report No. 4-At

Date 15 D

ME VS MI

B

FIGURE 2.1

CELIQUE SHOCK STATIC PRESSURE PA VS MACH - NUMBER! r= 1.400 : شوا *3*0 . . CETATHED SPOCK

1954 ... 11. • : 1::. . FIGURE 2.2 18

M, MAGH HUMBER

Analytin

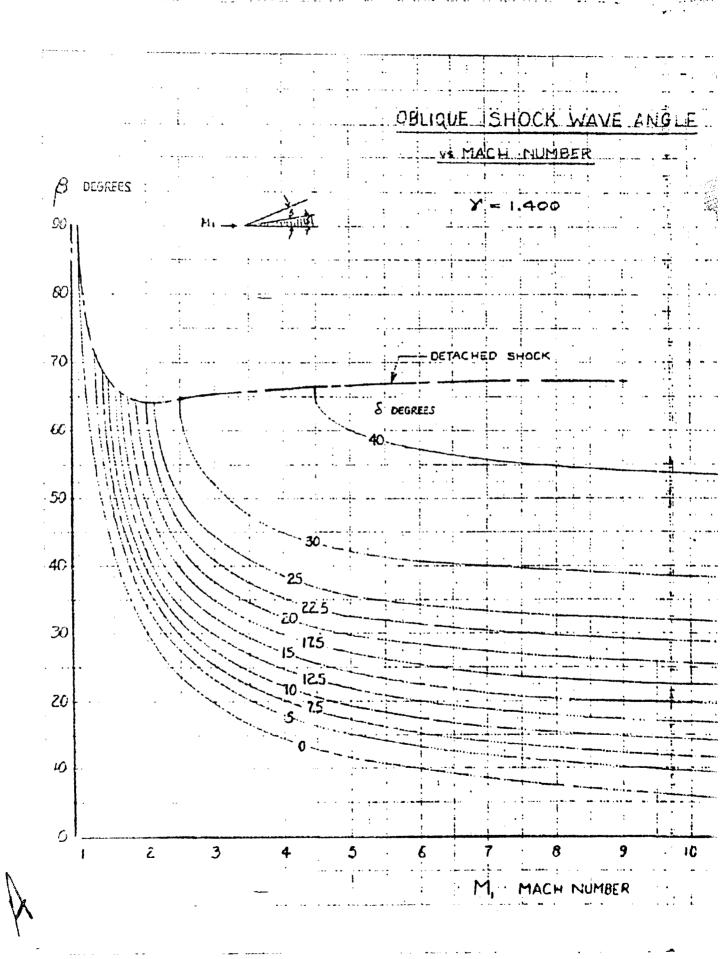
7.5

Fego Il Repert No. A-Clina-II Data 15 Duc. Il

To v. M.

FIGURE 2.3

Page 32 27 Ropart No. A-Atlas-103 . ţ. - | NUMBER MACH MIGURE R. 4



Report No. 0 I T

Page 36 Papert Ho. A-Atlac-103 Date 15 Dec. 1950 OBLIGHE YNOLDS NUMBER MACH NUMBER ---14. 12 T. P. М tarat' R 44 . Ti Ţ ... . , . . ,i.L: S [EST 125 11 211 -£ :i: 1.3 1 1 11.1 ---6 . i : 11. R 1. . . . 寸 1. į . . . 1 į. - ii: # . : ı FIGURE \_M 2.8 į., HER. 4-27-5

T

V

(m. 1. 2. 1. 1. m.)

And desired the State Co.

1

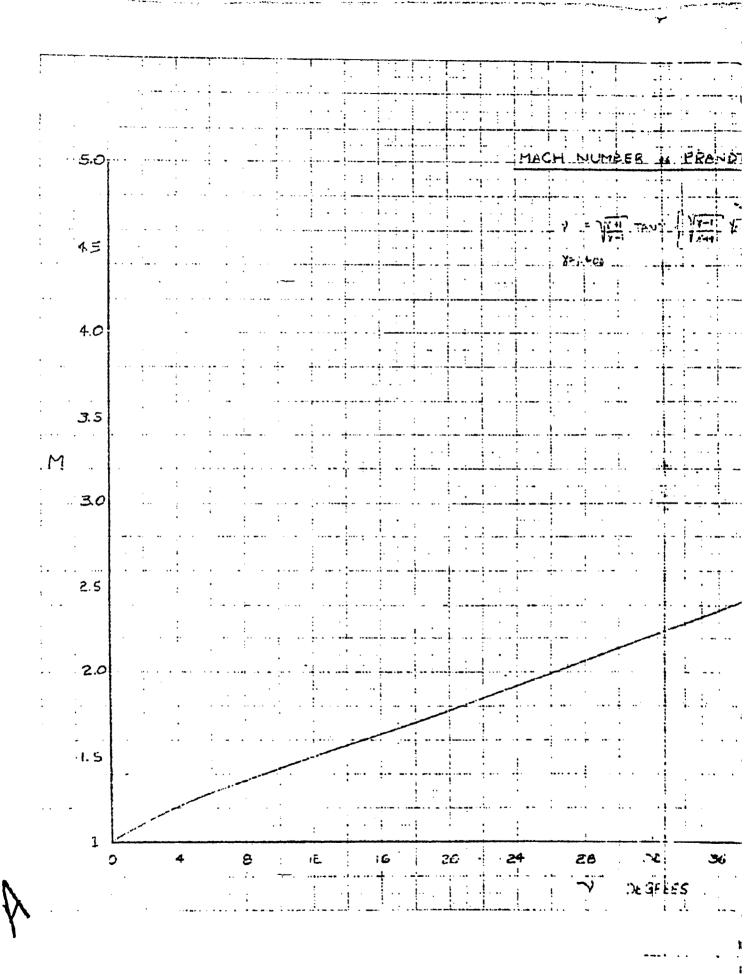
...

ADD BEELD BUTTERED ABOUT CONTINUES STATEMENT OF STREET STATEMENT OF STREET STRE

Page 36

Page Ny E DOMESTIC OB 10 VE SHOCK TOTAL HEAD RATIONAL MACH

1.64 -A-1164 ,

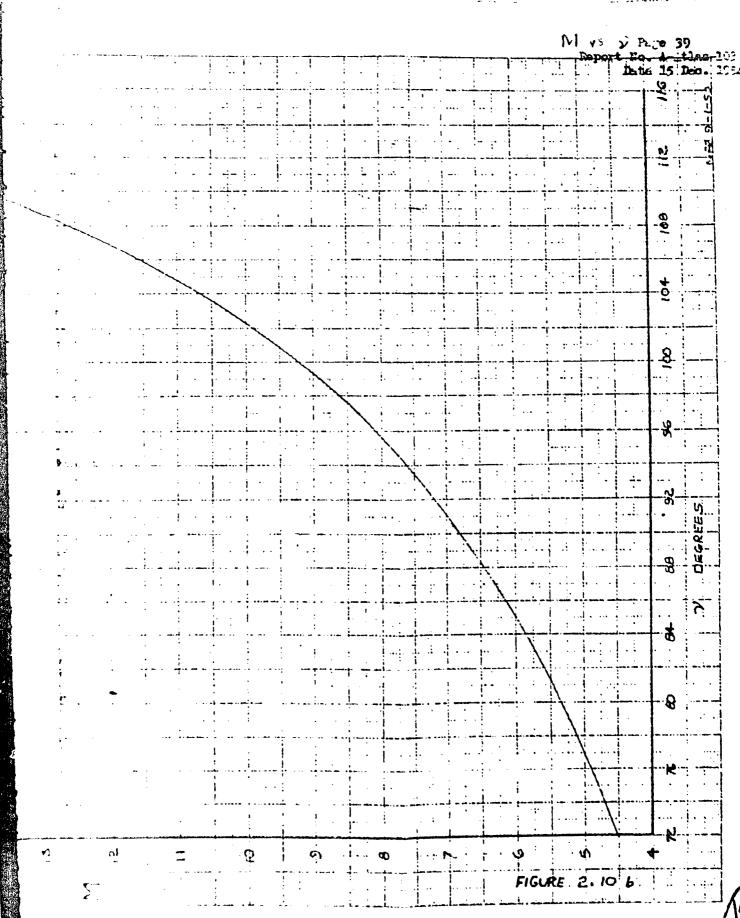


····	77	<b>4</b> 100 U.W.		<del>,</del>		1 : 1		•	<del>1 ;</del> -	<del></del>	<del></del> -		······································			M	Reper	Page t No. Date	38 A-Atla 15 Dec	s~l
					í ŀ			!			-		<u>.</u> .				- 1			<u> </u>
	•	. •	· · · · ·		- :				·	<del>!</del>	<u> </u>		·				<del>-i-</del> i-			•
	į.		<u>i</u>			-	: :		. <del></del>	<del> </del> -		· .		!						i I
3	<u> </u>	PRO	NOT	1-17	EYE	l An	I G L E	<u>.                                    </u>	i i	<u> </u>	<u> </u>						-		·   · ·	
	•		.!		!			• 1. •					! .							i
•		·			; <del></del>			;` ;		<del></del>										i i
(AV)	``-¦	1/4-1	. A.	<u> </u>	<u> 12</u> 1	: YA	I. I.	<u> </u>	<u> </u>	<del> </del>			<u> </u>							
	 i- :				!		<u> </u>				1		: !							
			:		<u>:</u> :-	-	i	ļ <sup>1</sup> .	i	į	; .; <u>.</u>		i							ì
•		· · -	·		<del>,</del>		<u> </u>			<u> </u>	j		<del></del>	<u> </u>			i.			i
	!	· ·	:			<u> </u>	<del>.</del>	; 	<del> </del> ;	<del>}</del>			<u> </u>	<u> </u>	<u> </u>	··				i
	-				-						i · - ·			<u>                                     </u>						
			Ì	i.	١															
•	} - ·		∤	· ••••••	<del></del>		<u> </u>	ļ. — <del>-</del>	<u> </u>			 !	i							-
	-	٠ ـ	!	;		<u> </u>	<u>.</u>	· · · · · · · · · · · · · · · · · · ·	<del></del>		·						·			:
	i.		; <u> </u>					i		<u> </u>	<u>.</u>	!	<u> </u>							İ
-	· -	, • • •						i	<b>:</b> :.											
	<del>j.</del> -			:	<del>!</del> !						<u></u>	<u>-</u>	ļ	<del></del>						<u>:</u> !
	:	: -	:: -	-			! سمر			<u></u>			ļ ;	ļ	<u> </u>					
						سننر	·		!			ļ • • ·		-;						;
		٠.											<u>.</u>	<b> </b> . : .						1
	<u>፡</u> ! 		ليبمسمسية			, <u></u> 		<del> </del>	<u>.</u>	ļ		:		<u> </u>	1					<u>.</u>
,	!	•	··	: !	:	<u> </u>	! •- • - • - •-	_				<u> </u>	!	<u> </u>					-+	1
	i i	<u>.</u>		 <u>!</u>														· · · · · · · · · · · · · · · · · · ·		į
		!		:	· · ·	, , , ,	! !		:			. ;-	; .						•	:
	<u>.</u>	· .	• •••	•			i .		• ·-• ·- · · · · · · · · · · · · · · · ·	<del>-</del>				1	<del></del>					
	!			. <u></u>	:	! <del>!</del> •	 !	<del> </del>	: : :	: <del>-</del>		<u> </u>		<del> </del>	-	L	- 1		<del> </del>	: 1
	•		·	•		i ::	<u> </u>	ļ 	<u>.</u>				i	<u> </u>						
	İ				:	·	:		• • •	!	,	٠.	-	į			:	:		İ
	:	• • :	•		:					<b>†</b>				<del> </del>						]
<u> </u>	١ _		<del></del>	<u></u>	·		<u> </u>		<u> </u>			<u> </u>	<u>                                     </u>	<del></del>						-
.ንረ		3	56 	· 4	0 -	- 4	4	4	8 .		2	5	<b>*</b>		· ·	· 6	+	58		*
35	F = 5	<b>S</b>		- ;•			i ; İ	!					-	!  !	FIGU	RE	2.10 k	L	_	
	•	٠	•• 2	1	J '			<u> </u>	I	L	<u>' ''                                 </u>				.i		11020	<u>2-15-</u> 2	أسلت المأسا	

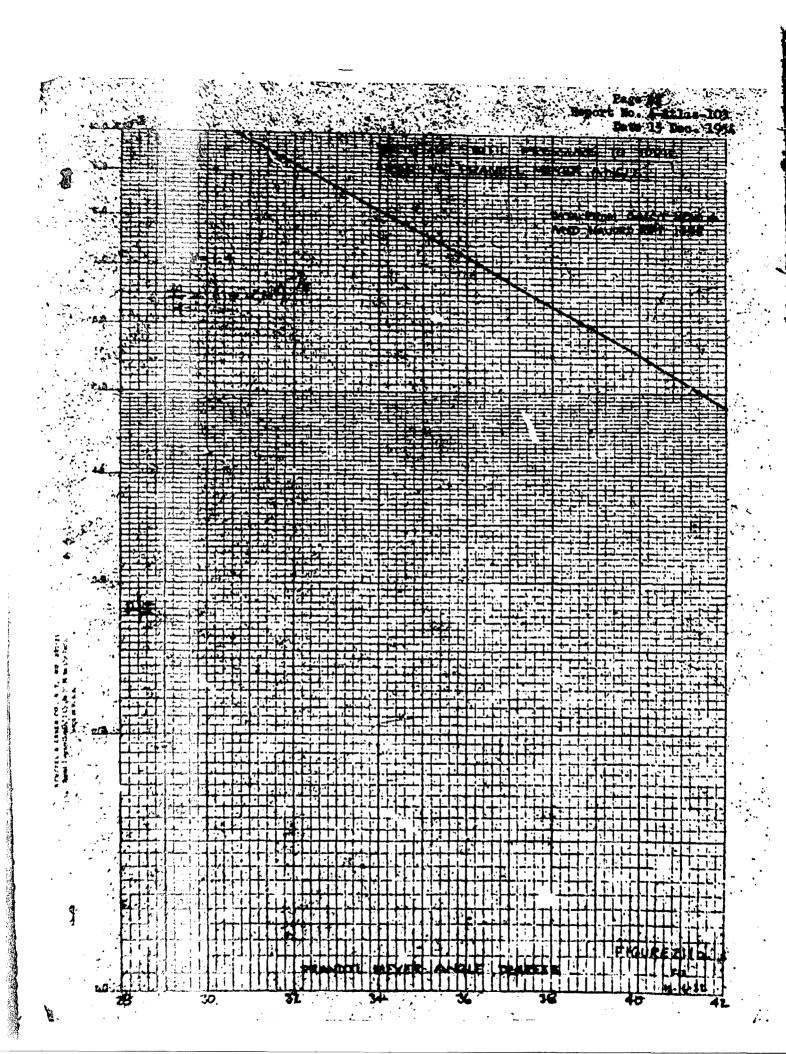
Page 38 Roport No. A-Atlac-103 M vs Date 19 Dec. 1954 FIGURE 2.10 p. 5+ E 35

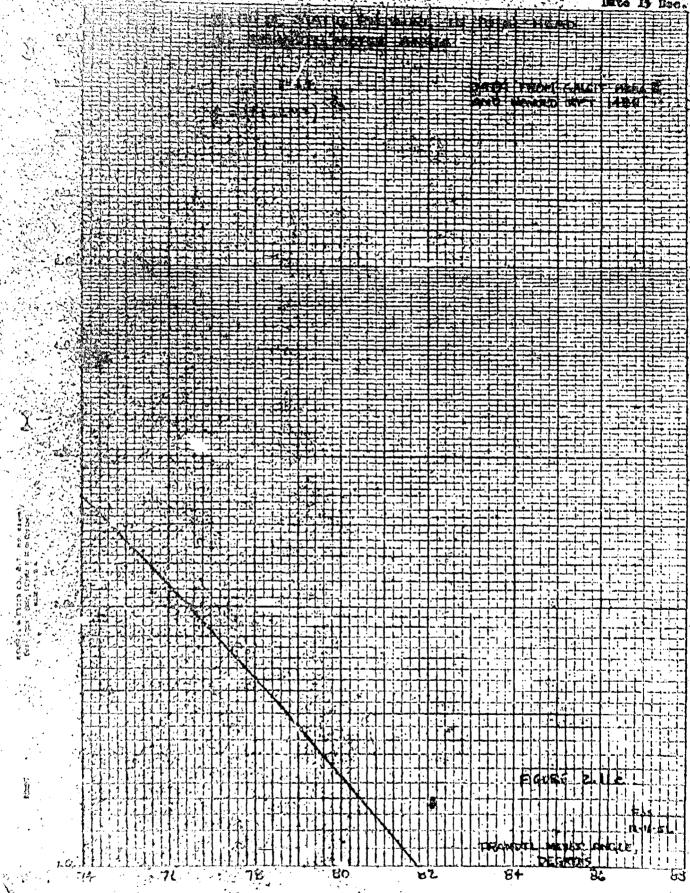
FIACH NUMBER AS PRANDTL-MEYER ANGLE

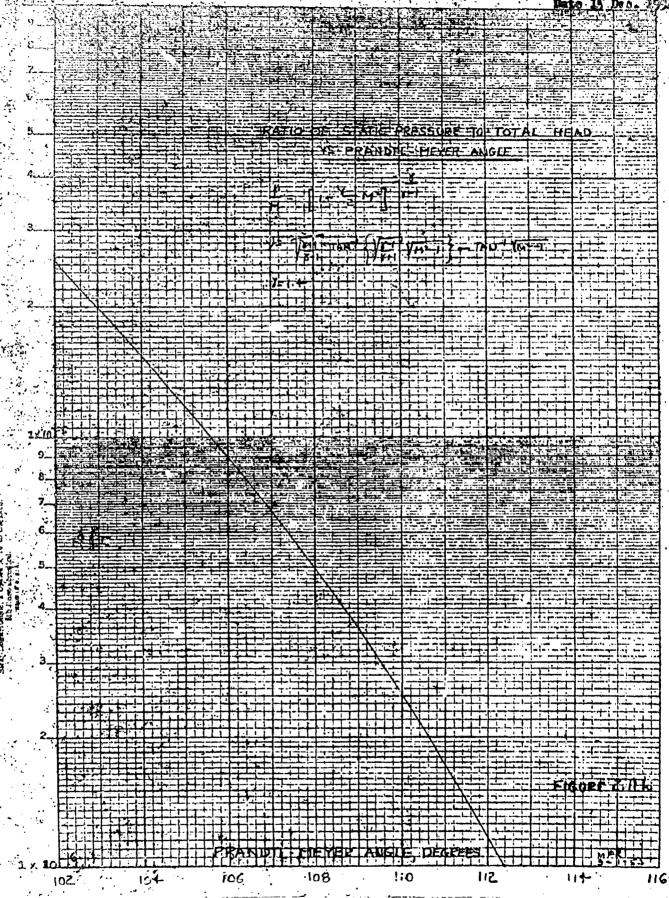
V



B







Page 53 Report No. A-Atlas-103 いいからい . . . . . 7 ( MACH NUMBER, M.

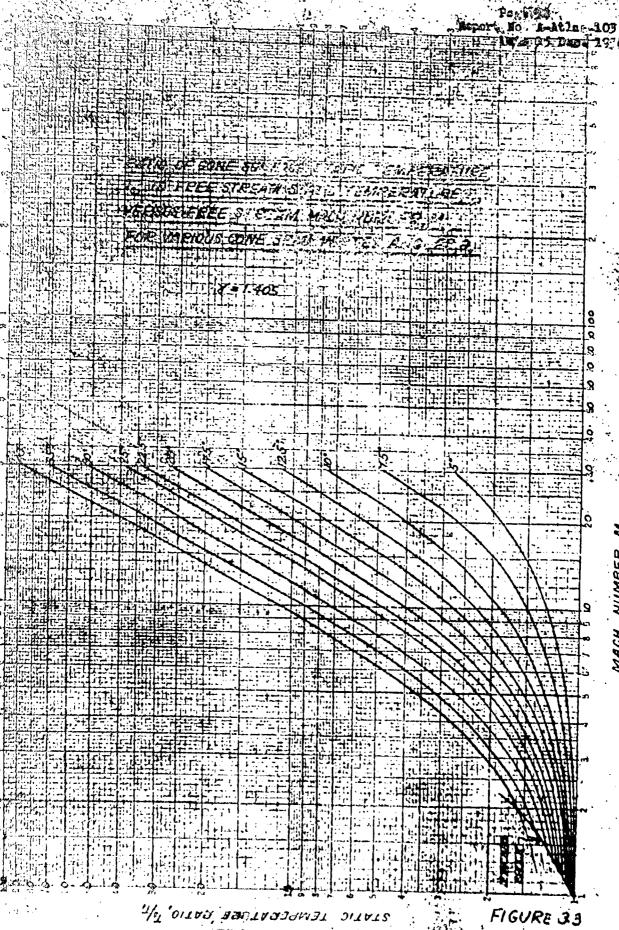


FIGURE 33

 $\sum_{i\in I} |x_i|^2$ Page 5054 Report No. 1-16las-103 o ONE SHOOK WAVE ANGLE SW. -CONE ANGLES: GO 1 ---....t 22 50 ----15 ... 12,5 20 125 1.1 . GV : :. -

Pago 97 Export No. A-Atlec-103 30° 围 MACH NUMBER, M.

John Braterio

Report Bo. A-Atles-103 FRESSURE RATIO, S. Dreamed ならずが 1, 10 MACH NOWBER, M.

WAVE DRAS CLEFFIGIENT OF A CONE LI COME ----- introce inches AREA ! BRISE AREA CA COME FOR MAICH NUTSERS 15-E-C X=1.405 06 ... 22 20...

V

CD VE BY Faport lio Date 15 Dep. 1954 -·:: i. T . . ! 1 - ! -77 • • • • • • 1 : **:** <u>.</u> i .... . 1: :1 :!: 7.3 1. , 1... ř. ··[ ] `i:..; + : .!., 1: :[ i 1. ... 1 # ï, LOGRESS dind

Cb vs Ov Papert No. A-62765 Hats 15 Dec. 1954 ·:... : ... Jar. :1: 11 1:.. i. | . . . . . . ... -----1 ...!.. \_\_\_\_ ... FIGURE 3.10 1: DAGREUS disclar-ce his

Y= 1. 405 CB CONE: ANG. 1.5 AC

•

V

\_ L

. . . FIGURE 3.10 b one: Aind

TAPLOR! MAKERY VALUES AREA . BASE MEET CE COME .26

N

, wante and response to the second se

CDVS Or Perse 61 Ŧ... Peport No. A-Atles-103 Pete 15 Pec. 15.54 14.3.0 Į, \_\_\_\_\_ . 1. 7:::: 1: -ī ... 1.1.1 -1.-: :: . . -:-<u>:</u> ! <u>.</u> T 4. . .... -:-. i : - <del>;</del> : 1 Lord FIGURA 3.10c

•	•••					<u>.</u> : -	i. i	1			- د ار	 					-			
		 		<u>ئا دى ئا</u>		· · · · · · · · · · · · · · · · · · ·	····						¥1.31.			CEN		-   -	<del>:</del>	-
Ç.				• · · · · · · · · · · · · · · · · · · ·		;				1	i. L <i>EI</i> 3	1	Z 7-	M.GLA.E			<u> </u>		,: 	!  -
													CC DEC					zsa:		
		; ;												÷-			1			
<del>-</del>	•	<u> </u>	1 :	·	:	<del> </del>			3.R.J.	ncii.			20.		M	<u></u>	<del> -</del>		:	<del> </del>
		: :	•		i	<u> </u>	ļ					1 : 4 ::-	<u> </u>					- <del></del>		<u> </u> -
	··· ·		! 		<u> </u>	<u> </u>		 				8=1.40		<u>.</u>	i . · i	l L		ا ا		
, , , , , , , , , , , , , , , , , , ,				<u>!</u> . i .				!		1			1	!	- :	<u> </u>				-
1		<u>,</u>		i. i.				† · · · · · · · · · · · · · · · · · · ·		-				:	ļ			a: .		+
16		ļ	} !		<del></del> .			<u> </u>			<u> </u>		<u> </u>	i					i i. • .	
٠	- <u>.</u>	; · •	ļ	<del></del>		<u>.                                    </u>	· [	<u>.</u>		<u></u>		<del>-</del>	! <b>-</b>	<u>;</u>	<u>.</u>			<u>;</u>		<u> </u>
15-		l !	<u>:</u> 		1			ļ : ļ	, 		1 ::	<u> </u>	<u> </u>	<u> </u>	ļ		1-:-	1 13 1		<u>;</u>
	:	:		i			l L	1		:			<u></u>			: 	<u>.</u>			
	:	· ·			:						<b>.</b>				-				ŀ	;
12.									 								1		ļ	
							<del>}</del>					-		<u> </u>	1.	<u> </u>	<del>-</del>		ļ	<u>.</u> j
ıc.		i		1	ļ				! !	7				<del>}</del>	1	1	-	- !-		-
							- · · · · · · · · · · · · · · · · · · ·	<u>.</u>			<u>:</u>				.L	+	ļ -			
. උප .		:	!	:			.i							1						
	:		•	1		:	1											•:	i	
		.1		1			-		·; - ·•·	1					- <del>-</del>	. <del>1</del> . - 1				:
CE		į.	•	·		. !	•		:	; !			-				. ! :	+		
		i :	•		•	: : .	: :		:			; <del>-</del>				.i	! . ـ ـ ـ . لـ . لامر			
.04		•		i 	:				:	<u>.</u> i,						تعنين	ALC: E	,-4"   16'3 4		:
			1		:	•	· -	:		ì	:	• •	i	التياميد ا			•			:
	-		• •	• • • :	•	:		·	;	• .		وسيرسد				1				:
.62		. :	1		. <b>:</b>			1.					1		· • • • • • • • • • • • • • • • • • • •	<u>-</u>	. <u>-</u>	1.1.1.		-: -
					: <del>:</del>		والمستعدد	فتستنت للنا			-+	_;	-	-	<u> </u>		. !	+ +	<u>!</u>	:
c			-	2/2/200					<u> </u>	·	. :	•	ļ	<u> </u>	-	:-	· ·	· 	· ·	· · ·
	Ċ.		1	i	2	:	Ξ	i	4	<u>.</u> .	<b>5</b>		á		7	i	€.		<b>.</b> ,	į

N

CD 43 81 No. 4-At les-103 .... 1 :..i Date 15 Peg. 1954 . 1::: ... 1 MUKROCK ز 120 12.5 25 <u>. i.</u> F 1 U : ! :.:.: · I.. :.. FIGURE 3.104. CONE ANGLOW GU - NEGRETS

B

						Iw.	(71)	47	Ax	AI	For	P / E		065			<b>課</b>	674
												r C				7.15.2		
C						Cx=	Ax	AL /	oxci	F. C.	DEFI	FICIL		(co	NE.	BAS.	E 47	EA:
						1 .	1	1	SE		i .	1 .	, •	1 .	٠, ,	1 1	Fæs	)
							FA	NGL	- 01	Y = 1	<u> </u>	i	(RI	DIA	NS)			
F											<u> </u>							
	11																	
			1															
***			/		-						·   · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·					25 A	ļ 
<del>} </del>													-					
3		II						$\Theta_{\nu}$ :			 							
γ ζ			1					55				:						
3			1			10-	52					: : <u> </u>						
				20	23	く											******	
4			X	EST	The second second													
					3 <i>7</i>	40			5				7					
													M	AC	ΗЛ	TUM	BE9	A

-2,

The second of th

EXC		7			5	25	تنار		,	Ψ.	2:1/3	7.4C	4 Z	Ung	BE	9								eour	i No.		ler-
	 		 	  - 							. 1	.; : <b>;</b> **															100
	1:					÷		<u>-</u> :-		+		-+															<del> </del>
2	Ħ	15.	-	A A	£	43	Ŕ	Æ	EE	RE	NC	E Al	EA														
$ar{D}$	El	R		5	)								<u> </u>														-
	<u>.                                    </u>			<u> </u>				·		+	<u> </u>				. :::												
/.S,		1			1::				- !-													-		#  -	-  -  -		
: ::		<u>:</u> _		<u>.</u>			- : -		-  -	_1_											<u>I</u>					ļi	
نــــــــــــــــــــــــــــــــــــ	-	-		·			•													:: 1				·			<del> </del>
	-	<u></u>		_		<u>.:</u>				+						1:  1:1 1: 11: 1:	. 1		-::::::::::::::::::::::::::::::::::::::								
			-							 	-																
	1			<i>3</i> .			. :															-	: : : : : : : : : : : : : : : : : : :		-	T	
										Ė								1				1			+		
	-	-:				;			i		<u> </u>		<u> </u>	1:::								+	1			1-1-	+
		:	:	16.		!			· i-	-		- :-															
		1	1-	2			_						A	OTE			10	75	) = 	01	7		N)				
	+-	<u> </u>	1		-	<del>: -</del>		نـ		: <u> </u>	<u> </u>	<b> </b>	1	OTE		CX a=	J.J. 	VY O	1		1	UK.	ZV	F 187	· :	1	
			1::		<u> </u>			_		1	:												<u></u>		FLO	) NV	
•	-	-: :			-	<u>-</u>	- :		• - j-		· • · •			-			<u> </u>				-		+-		1		
	1	-	1							-			<u> </u>	į ;									1				
;-	-	<u>:</u>	1	<u>.</u>	<del> -</del>	: 			<u>-</u>	+										1 .::		+	•		+ + -		-
	. j		1		ļ	<u>i.</u>								-									1				1
		· • ·				:			- :		<u>.</u>		ļ.:	-	-				1			-	-				-   -
	ļ		-		-	-	-			.  .					1												
	+		<u>-</u>	<u>11</u>		; ,,			· ·	-+	<del></del>			-							<u>: </u>	- !-	••••	ļ		+	++
	1		-	<u>.</u>	-				- 					<u> </u>						Lx		//S	YN	$\theta$	= /	20	91
			-+-	è	·		-	-	. :	j.	. عنائت.	-		-					-		<b>X=</b> (	וט		M	-00		-
	-		+	<u>::</u>	-										-								1_				1:
				0	-																						
			-	5	-	:	<del></del>			<del></del> -		<del>                                     </del>											-				
			9		+	. 1	0	 <b>;</b>		1	7	- 1	2	i.	13		4.	1	4		6		. 1	7	+	/8	
1	N	JN.	B	E 4	!	Ī	:					<del></del> -								F	GL	RE	క	J.J <sub>-</sub>		-	FJD -22-5
<del>-</del> -			. L	i	÷		L	<u>:</u>	<u>ii.</u>				18 18.	<u> -</u>	1	1.41.4				18.37.3	<u>.[.:::[.</u>	<u> </u>	نلتك	تأنينا	<u>lsini</u>	.14	-52-3

= NORMAL FORCE COEFFICIENT (CONE BASE AREA = CONE SEMI-VERTEX ANGLE (DEGREES) ANGLE OF ATTACK (RADIANS) 8=1.405 1.8 MACH NUMBER

X

( day ) Losethy VS M,

	- 1-4.4	71		122	11223		,		स्टब्स			æE	1		22.71	-	<del></del>		alas la				,,,,			-		١ ,	امد	).	٤,	<u> </u>	(Q)	52A	٧	V.	, i	١,
100	6					N	,	+:	A	, .		-											4									Pa.	48	4				
- Links		-	-		7	· · · ·	A			Ψ.	M	븬	E.A	-		$\vdots$			-	+			:::						R	Ψ				A	4	امما	Hi	#
'i::	+	1		1, 7		7:1	:::	: :-	:- <del> </del>	:	:::	1										-	**	-	-							Del	40	15	D	<u>-</u> 0	15	7
		1							1	1								-	-:1		-	+				#									111		<u> </u>	
							- 1				-1	1			:::					1		-	H				<del>-   </del>	-:1								#	1	
ASE	A	4	À	1	7E	EER	51	10	- A	R	F,A	X					: :!																					
: 11: 13	1	1	<u> </u>	-	-		L	3.	: 1		-:1:	1			: : :		-:-		1111		1111					:	••;!											
. (. 2.			<u> </u>	٠.				! !				4	: :																: :! 					- 1			_1	
		- -		<del>ا</del> ــــ	$\vdash$		-			-	+	-+	-							-	-	井	7	77	, ,	,,	<u>.</u>		-/	/	- 2	7	_	=  =4	<b>つ</b>	7	-	7
		-1	· -i	ļ	ı İ		-					$\dashv$					-			-	•••••		16	.4	N/K	74	Ų		Α.	_0	5	4		=	نہ	U	JŲ	
		+	<del>-   -</del>	-			<u>                                     </u>		::1:		:::	+				:		***						-	-1			-/	•				M	=	Φ.		$\dashv$	
-		-			:-		<b> </b>		-			$\overline{}$		-:										≝		=		=	=							==	≝	
		-		<u>;                                    </u>	-		-			$\equiv$											_		_	=	-	=								日			-	Ξ
	-	7		-			-		-	+	-	· · · ·								_	. 1.	=	:						:l	. ::			:			-	-	-
										+	-4	7					:									$\overline{}$	I	::							::::			
			l	بيا			L				<u>l</u>	_	• • •									$\vdots$	:!							.:	:::				سنن			
بسسسد	4	-		١	: 	<u>                                     </u>				<u>.</u>		_				Ĺ	ļ.,	, 	<u> </u>					<u>:  </u>		:::		_		نعند			•	<u>i. :  </u>	:::			
	<u> </u>	_		!			#			4	<u>:::</u>	듸				<u>.                                    </u>						_					: :	. :						<u>                                     </u>	•		انن	۰
: 1	ا!. سللند	-4	سنبي	1_	ļ		<u>. -;-</u>	ļ		+			ا ا	:	_	سننت													-::	::::	==		.:.				+	٠.
	14.	4	<del></del> -	╀		<u> </u>	4-	<del>-</del>	┝╌	1	_	-			-	<del>                                     </del>		1:	ļ :-	$\dashv$		. 7	::::		:::!	7	77				-	,		2.	-		7	ハ
	==	-	·· <del>·</del> :			سنسنا	سنبلم			-	- 4			~ :				-:-				Y	27	E	•	ع).	1	w/«	JA	W	0	<i>ICI</i>	W	20			{	1
7	100	=		-	-		<del> </del>	1 1	-	+	-	-		::::	-		-	<del>: ·</del>	<del>                                     </del>	$\dashv$							<b>3</b>	i. 1				• ••		F				-
البسيد	164	•			:		+		-	. +		  -:-			-	<del>-</del> -			<del> - :</del> -							Γ	W.	ZV	2./	7.2		LZA	W.	7.0	O.	W.		<del></del>
	11	-	• • •	+-	<del>!</del>		+-	-			<del> j</del>			::-:	-	<u> </u>	<del>  ``</del>	-	-			÷					•	-	:	:		::						. : :
		٠. !	. `	1	·: ·-	-1.	1	"			11					1.	:	1			: 1	-:										-						
	1-4	- 1	•;,		:		i		-	_	!	_			1::	<u> </u>	-	:							1.								. :		1.		: 1	_
	. 1	•	• • •	-	::		1	1			• • •	:::					1	Γ-				•	:									Ţ.	•					į:. <u> </u>
I	1-12	•		1	•						: :				:::																		::. ::					:
		_	·	1.	<u>. L</u>			<u>:</u>	1. :1:		1					<u>.</u>	<u> -                                    </u>	i .	<u> </u> i		:	• • •				<u>::::</u>		i: '								i		<u>; ; .</u>
	1	_ }		1	<u>i_</u>		ļ	1 -				-				i :	ļ.:	Ľ				·							::: <u>:</u>			<u> </u>			1.			.::
		_ !		1	<u></u> .		<del>!</del> _	•	<del> </del> -	-	!	_	<u>_</u>		-			<u>.                                    </u>						-		:::					. ;;			<u> </u>		-		:
. <b></b>	: :=	_		1	<u>.</u>			<u>.</u>		•					ļ	<u> </u>	-	<u>.</u>					-1	<u>: -:</u>									-		:::			1
		-:	<del></del> -	÷.	÷	<del> </del>				+				-		+-	<del>                                     </del>	<u> </u>	-	-:-						::::	111				:::		-		-::			::
:		!		ļ	<u>.</u>	-	 	.i				-···			-	+	<del> </del>	-	<del>                                     </del>				<u>:- 1</u>			<u> </u>	-	-				-	<del> </del> -	-	-:-	1		
. <del></del> -		÷.		+-	<del>+</del> -	† . <del></del>	7						-	-	-	+	<del> </del>	<del>                                     </del>				:::			::::	••••		::::										
-	-		· ••	+	+	† "		;		*	•	-		 i	- :									.11	iii	+								-	::"			
	<b>†</b>	-			<del>-</del> -	1		:	<b>†</b>		-				1	,	1					::::						13:	•				-1-1-1		-		1	
<u> </u>				Ĺ	1	L.	]	:												•		:::		•														•
[			i .		1																				-		E							:(		!	-	
			<u> </u>	<u>į</u> .	:	1	1					:::			1			<u> </u>		•			:::							<u> </u>			11.				ننا	
1.				. }	i .	-	-	. i_			:		<u> </u>	<u> </u>	<u> </u>	: :		1								···•		<u> </u>	إبنا						٠		. : · . i	
<u> </u>	1 11		1	. !		-	+						L		-	1:	<b>_</b> _	-		:		: : 1			-	***	_		بنيا		_			_				_
	\$ .			10	-	+- 4	//	į:		_/	2			J.	3	:		1	4	÷		1	5_			. 1	6	i		2	7.	<u></u>		1	8 ::		ــــــــــــــــــــــــــــــــــــــ	1
M.E.	3		<u> </u>	+	÷	+ +-		+					-	1:::	-	-	-	<del> </del> -	1	• • •		:: (						<u>!::</u>	7,-	11	5	<u>:</u>				-		-
3.C.	<u> </u>			1	-	1	1.		<u></u>			<b></b>	۲÷	T .			+ :	-	:-					•			†:	. <del>بيو</del> . استار	יטין		KE	٦	•. <i>1</i> .	~	i	اا	FJ.	0
	ايا	١.	1		<u>.</u>	سلحماء		-نند	أسنا	لمنند		:	<u></u>		ــــــــــــــــــــــــــــــــــــــ		غسا	ــــــــــــــــــــــــــــــــــــــ	سننا			٠٠.	اــــا	<u>.</u>	ننتنا	***	<b></b>	<u> </u>	لنننا		<u></u>		Li	لسخ	فنتنا	- 1		

3

V

			· • • • • • • • • • • • • • • • • • • •		~~~~~				~ <del>~</del>																	۷	7 C	× /c	z.	A 7	10,	ŧ
C ( D )						J					ايرا			,													Ta.	25	65			
(C. (A. (A. (A. (A. (A. (A. (A. (A. (A. (A	10	400	14	-,K	v: E	μ.	I F	Δt	K	16	<b>4</b>		VIS.	<u>W</u>	AC	<i>H</i>	4	L.S.	1	EA	崖				Re	pert						
AC, (SW2 = 1-3SW)  AC, (SW2 = 1-			3			1						-		-							==		=	4		87						
	J-JX-	<u> </u>	11/2			-								-	-			: . : <del>: :</del>	4	- 1	<b></b>		<u> </u>	1	:	LVE	H	10	V/A/	11	D)	W.
	-					.:		:- <u>i</u>				_						-		: 1.::						.esc			•	,		
				_ _		1			<u>  </u>					i	_	!	_	.:::			1: "					Liv	45	W	Z	1-3	M	Νt
	Perel		وانصا	7	$\mathcal{E}A)$	<b>)</b>					1	<del>;</del>	<u></u>	-i	:								H		-  -	7			بناند		+	7
	i					1	.! ]							_						11.	1											
		·. II			1			إننا			1			Ţ				!					:		11111					- 3.07 - 7.55	=	
	1 1	<u> </u>			· :	Ŀ.				<u> </u>	اندا		1:-		<u> </u>				1	31	1:::					1						-
				: 1	, ,	1	_				1			سنا			_							-		1				12:	- نتو	
			<u> </u>		مسروي	-				ا	I	لمبي		<u> </u>						• :::	Ŀ		• :		` 1			ادند				
	Authorite	مسئلنسند. : ال	1.	-	- مقالته خانتا حصیصید	٠.	سميد			1			·	Γ				نسا			-				: ::::		÷.,	.: ::::	::::		<u>: </u>	1.
	1 .			الم المان		1				1 1 1		أن	سأنس	-	1.1.				-		Ţ								1		<u>.: :</u>	
						İ		<u> </u>	أنسنا	-			7:		1					: ; ;	-		:::						111111			. :::
	and an artist of	THE TAKE	مع مسا	7	-	-			-		1			1				<b>†</b> -:-			1		<del>     </del>							7.50		i ita
			تأسسا			+-							<del> </del>	1	<del>i</del>			:::		1	#	1				11:	-	- : ! : : : -		1.1	1	
			T:::		- ; - ;	+-			<del>     </del>				<b> -</b> -	+	<u> </u>	1		-			+:	<del>  · · ·</del>				1	#			1-1	1.	
	أستعسنا				+	+-			-	<del>                                     </del>			<del></del>	+-	<del> </del>	-	-		-		+:	<del>: </del>				+	+	<del>:    </del>	1		٠	+
		-7		-		-		-						-		<b>-</b> -		1	Ţd		+	1	لمديية ا .				1		ļ.: H.	7.2	T	
			1		_ _	-								-	1.:	-	<del> </del>	-		11:	+	+					=:[-			+	+	
	ļ i	- 1		_ -		.			<u> </u>					4:	1::	1	<u> </u>	ļ		<del></del>	┵	<del>  -:</del>		-			-1			-		
	1 1	بميلا	1		.   .	_		<u> </u>	<u> </u>	i_					1.::	1:-	<u> </u>			<del>  </del>	4::	1					-	<u>:!</u>			-	
				.					L	<u>                                     </u>						ļ	<u>i</u> .:		_			171	<u> </u>							4		<u>.  .</u>
		]:		<u> i</u>		[:-	1	<u>                                     </u>	i .						1	1	1	-	_::	1	1.	1:::		!!:::	11:11:	1 1			<u> </u>	4		
			L		· ·   			ļ	<u> </u>	L			:: 1:		<u>lic</u>		1:												<u>  -</u>	4.4	4	-   -
	[:-:]	25.		.	11_	1.	. !	_	<u> </u>				<u>                                     </u>		1	<u>: :.:</u>	<u> </u>			<u>: :   ; :</u>							::	17.		1 .:: 1		- 1::
		1	-		1				;			:	1	1::			1:::		•												1	
			ļ. ;.		-1		1.			1. 1.			l			Ţ	:::		.::		.: :			ii:::	::: !	: : : : :	-;					• ;::
		0	1	10		-		1			10			18		1	1	L			15	1		7	2	1.5	1	7	111111	19		i /
			1		•	1.			1						Π.						1.			-::					·		·.].	
	11116				Ι΄.		1	1	1.1.						11:11							1		1	11.11							
	W. C. C. Shink					-			Ť	7	7					7			. 1					1:::								
			1		<del></del>		<del>-                                    </del>	1.	1	1			1				1						-								]	
	(   -   -	1	:		· · · <del>!</del> ;	1		: 			<b>-</b>  :::						-	1			-     -	:	1								[	
		+	1					-	<del></del>	<b></b>		<del>: : : :</del>	1	1.	<del>:: :</del>	1		<del>                                     </del>			+	Ť	1		1: .:			11.1.1				:: 1:
	4 : " : "	1-1	1		Ξ					+ +	. : 1					+	+ -	-	المناط	+	+	1.7	╁╌			1				1	-:	.::
FIGURE 3.13	1								1-	<del>                                     </del>		-			-	-	1	+-	. :				1						i i	+-	$\pm 1$	
	1	1 = 3 =	-			1			-	-		-		: ::	11:	-	1		ļ <del></del>		-	-									-	• •
	1			. •	• •							1		- -	11 11	-	1	1	-		- -	- 1 - 1	-		11			1. 11.	111111	+ -		
	}·	.].		-:	المنظمة إليا										-	-	1	-			- -	<del>:  :</del>		#	-				<del> </del>			
FIGURE 3.13	3				: 			<del> </del>	1	- <u>-</u> -			1		-	+-	<u>:</u>	+-	-		- -	- -	-	<u>!</u> :-					+		-	<del>:                                    </del>
E16URE 3.13	4	1 3-	. ļ ;		_ 4, .		-;	- <del></del>	1:-:			<u> </u>	-:	.	<del>-   -  </del>	4:	·!	ļ.,						1	<del>                                     </del>	1-1		11.11.	. - <u></u>  -		-	
FIGURE 3.13	<b>1</b>	1						·}	<u> </u>		_ _			4	-	-	<u>.</u>	4::	<u>i                                     </u>					-	1:1	-	∤		1.4			
FIGURE 3.13		!1:	!				· . i	1.	i.		<u> </u>	·		l:_	ļi:	<u>: </u>	ļ	4::		<u> </u>	-	-	:	-:		-	=					٠. ـ ـ ـ ـ ـ ـ ـ ـ ـ ـ ـ ـ ـ ـ ـ ـ ـ ـ ـ
EIGURE 3.13	A.		1_:		1	1.			!: '	1 1	1 3.		اننا				1	4	Ŀ	النينا	4	1:	1	<u> </u>		<u> </u>			1			
EIGURE 3.13		17		! ]	. !		!	_	.1								1		<u>                                     </u>			1.	4	1		1.11.						
E16URE 3.13		1.		·- :	Ï	Ţ		. j.		1		1	<u>  </u>		1.		1		<u> </u>	<u>  i</u>	1		Ŀ.					· i i .	1 1	_		<u> </u>
FIGURE 3.13						. i		[:	;	1 :		1			1		11		<u></u>			11							<u>                                     </u>		ان	: :
E16URE 3.13		1	7	·~· j					].													, F.:							1:	1: :		_:[:
			1	,		'n į		1	-	1 .i	ī	1.	7		-		1					:	1.			F	61	IRE	3	13		
The state of the s		-	1		; ·		1			11	- [:-	1	1.	-	-	1.::							1					anië.	1.			
		.6.4.54		,		. !.	u		4	سائد شداند		.Li	با سيات			ما ۔	<u></u> :	-		ه المحققة							1		- 1		للبيينم	

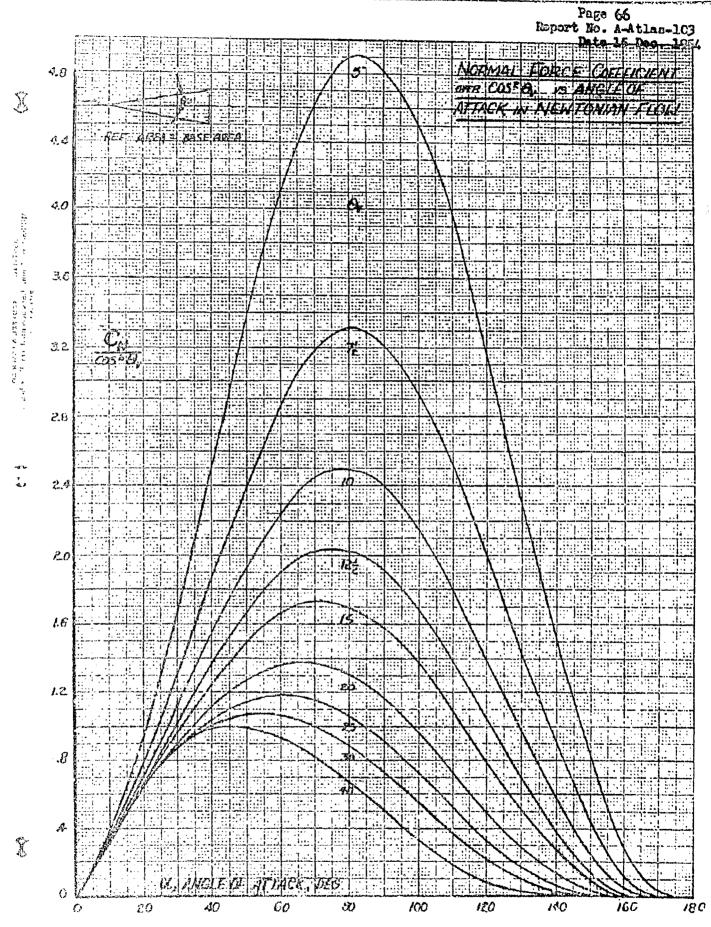


FIGURE 3.14

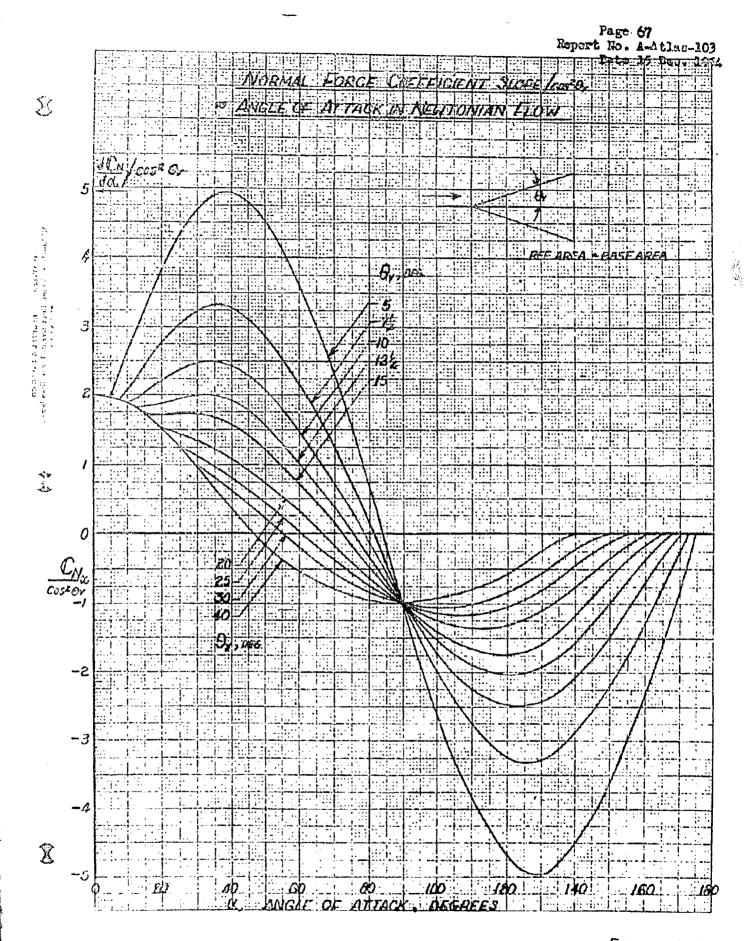
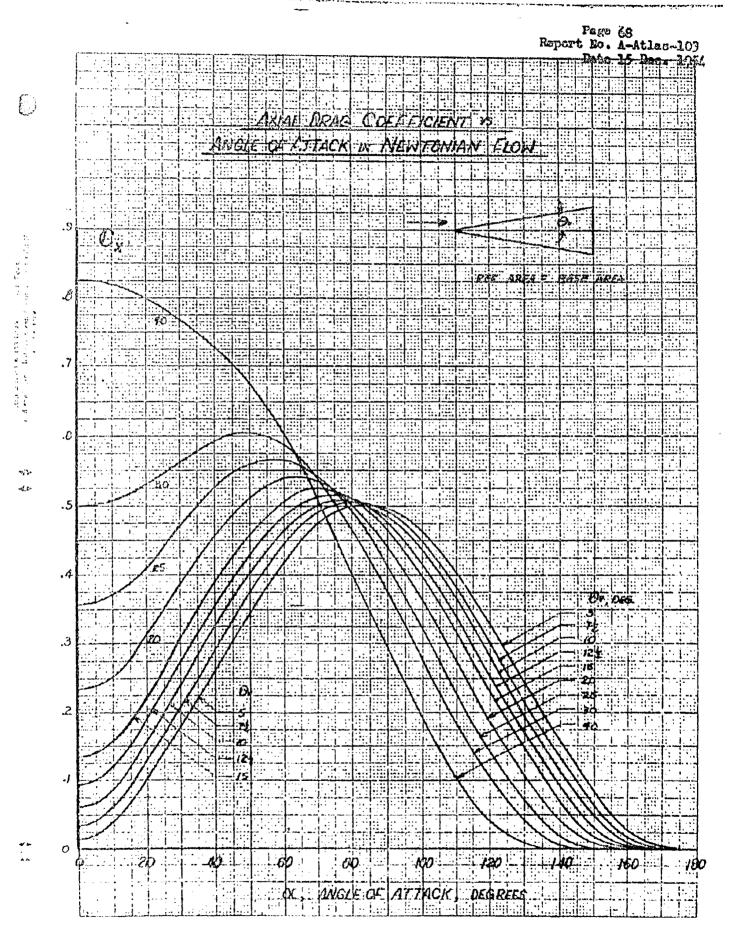
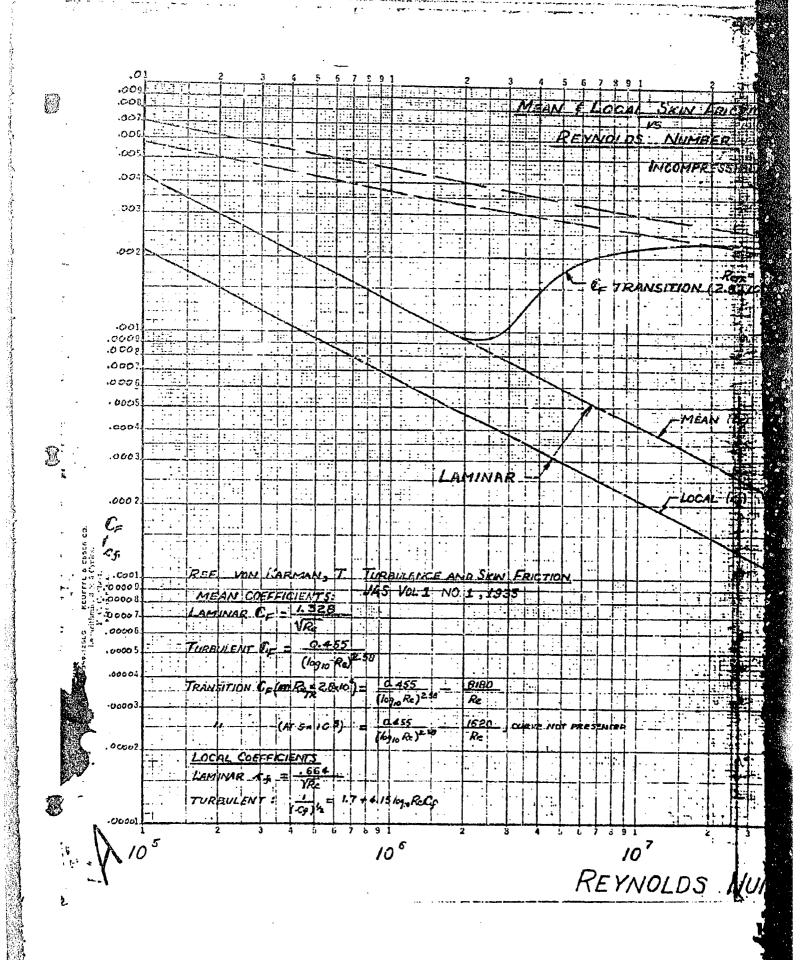


FIGURE 3.15





Report No. A-Atlas-103 Date 15 Dec. 1954 CF & FF VS RE 103 108 FIGURE 4.1 NUMBER, Re

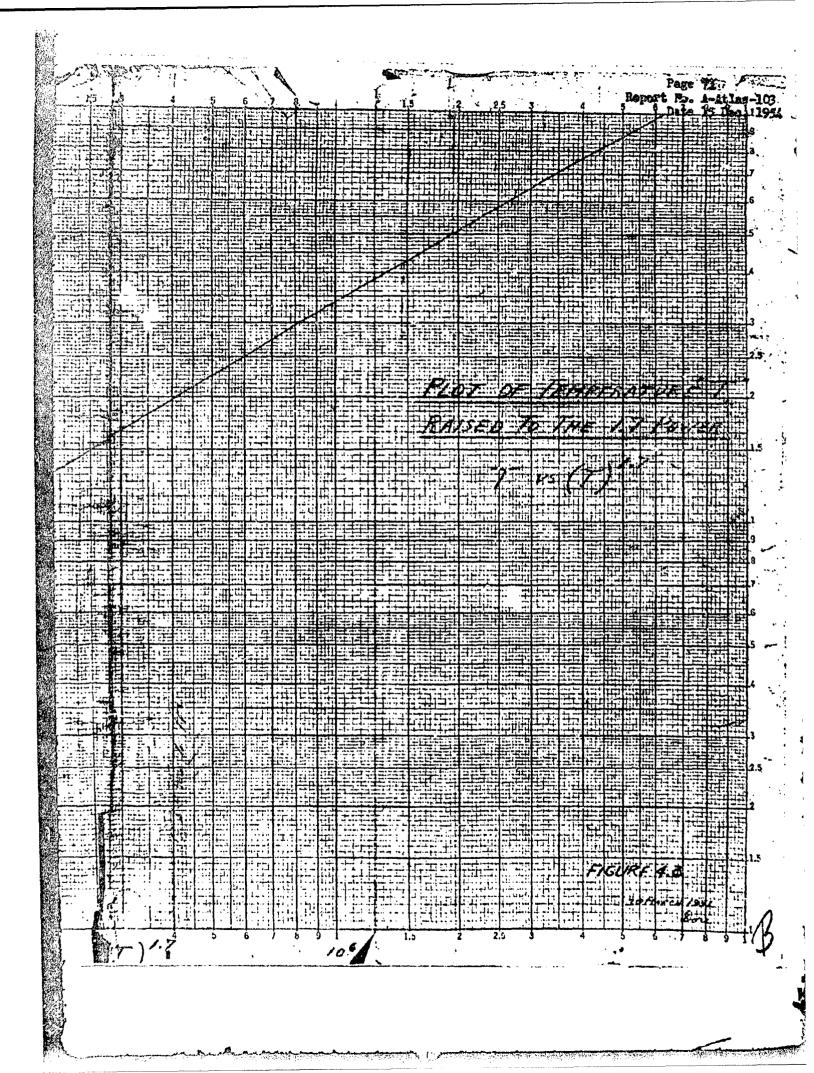
Page 70 Page 70 Report No. A-Atlas-103 Teles 45 Peg- 1954 1.5 TIE: 1. 7:11:5: :::: 5 ; ; ; ; -7: .... un H ----TERMATO ... 7217 77.11 7.5 ļi:: FIGURE 4.2 

Troubles and the factor of the second of the

I

. 2

A10KE 2.5 2 1.5 Bho CEGER CO., W. I. CESCR CO., N. in haiter 1 1 ::: 4 105 A PROPERTY OF THE PARTY OF THE



Page 72 Report No. A-Atlas-103

1.1. 16		بيا حوبان.	7	1-1			10=-				<del></del>		<del></del>			<del></del>	,,,,,,							100	hoi		MU.	• £	-0	tle	ا الله الله الله الله الله الله الله ال	-
			-	15	1			1:2		<u> </u>		::::			ļ:	144				::::							2.5		7	Dey		幽
			$::\cdot$		1:4:	1111										T::			==	ı.:E.	::11		-11	Ē.	::::	==	-	1111		1	•	
40.13	1		1 .	1 ::	J.Eji	:-		1	::::	· ·	1		1			F					=====	===						1	=:		1	<del>;:::</del>
	13,11		17-		111	12.			=-	<u></u>		<u></u>				٠				1	122		111	1	115					انتنا		E
				1	1:::	::::	11	L	E	RE	N.		Æ	M	Œ	R	7	UP.	F	_2	15			17				1				1:-
	13.1		:}::::	1,	17, 5		-		-	. :	-	· · ·	ļ		1	-						]	-	-		::::	-11		1111	13.5		
12.4	155				i :	1	122					-	111	7.											H	1						1
	1		-			-	=	-		T_	==	1	ĻΔ	<i>I</i> .		1. ::		11.1	:::.1	-1:4		1	-	-				<u>                                      </u>	<u> </u>			
	1- 1					•	3.5	:::		ļ.,		<u> </u>	: ·		::	i:		:::			3.3	*:::		1	1111	i::::		1 7	12:	ļ:;;, <b>,</b>		i: .
		3.H.:	1 :	1:215	1	1:2.1			::::		:	11.	Ĭ ::	1:::							===	25	::::	1111					-	1		<del> </del>
-1:	i e		1.5.	1	1-1	<u> </u>	1	;	: 12::				<del>}`</del>			<del>                                     </del>			1 1	•				⊫	1	=	=::	٠				<del>;</del>
				-				انتيا				ļ:: <u>.</u>		· ·	<u> </u>	-				3	.::	:		1::::				1::::			<u> </u>	1.
	$Q_{-}$	1111	<u>:::::</u>	1. :::	11111	1:11	1:::	11111	•:::			l :::	l:::.			1		::::	:	: 11		-::		l::::						1		
$  \cdot  $	1	13-411		1::2	=	11.3	1111		11:45	1	:	1 : •	1		1::-									72.		1	1::-	-	1	:	l.::-	<del>i-</del>
	1		1	1	137	1	-		=	<del> </del>		+-:		<del> </del> -	<del>                                     </del>										-	1:::		├	ļ	i		4.
		1111	1::::	<u> </u>	1:::	1	<u> </u>			<u> </u>	<u> </u>	-		-		11.5		انت					<u> </u>			1:::	1	<u>i: :</u>	1::-	<del> </del> ::::		<u>.</u>
	1::-1	1:11		1:-:	::::	1. :	:::	:;:•			:.:	·. `		1	l:::.						***		: - :	17:	1.::	1:31			15.5	1351	1:::	١:-
	h .			T		1 -		1211			55.	1: :		1	1	1			.111.				: 1	/:·	<del>                                     </del>	l::::	ļ	i	1	<u>                                     </u>	<u> </u>	+:
	φ÷ι				1	<del></del>			-	<del> </del>	<del> </del>	<del> </del>		<del>                                     </del>	<del>                                     </del>	1								4::7	1			1	٠	<u> </u>	1	-
	اننا			<u>  [[]]</u>		<u> ::::</u>				<u> </u>	<u> </u>	<u> </u>	E.			1				:::			ľ	7:	] : H	1::::	<u> </u>	<u>;</u> 🗀	ļ:	[:	<u> </u>	j:.
] <b>[</b>	11.1			<u> </u>			::::			:		- 1			[]	13.		H.,	::::		1::	1:1:	7	7.	1.:	1: :	-			1:::	-	Ţ
			1:::		1	T			-	<del></del>	1	1			+	<del> </del>		÷				=	۲.,	+	11.5	•		<del>                                     </del>	<del>  ::</del>	1	تبنا	+
1-1	إننا		4:::	1-:	:-::	ļ::::.	<u> </u>	<u> </u>	<u> </u>			زا	ļ <u> </u>	1::::		۱	<b> </b>					J	1	1	1::::	1	1	<u>:</u>	1		<u>.</u>	!
4	7		1 ::		-1-	l:.::	333			l::::	1:		Į	1: ::			i i	<u>.</u>	:=::			1	<b>V</b>	<i>[</i> :::		1:::	ļ ::.	1 :	l. :-	i ::	1	ij.
				Tiani			T:::		:::-	1			1:::	1			1111				:::	17	7	1	T	1		1:		i.		
			-			-	-			-		ļ	-		<del> </del>			-			7	7	1	1:::		1	-	1				1.
		111			1111		-			<u> </u>	١	12	25		DE.	Ko.	M				1	14-		<u> </u>	13.2	e.	Y.E.	ST.	10	<u>i &lt; 4</u>	كنقط	ij.
7	1:::		<b></b>	1:::	<u> </u>	1::			:			2:::	۵			9.7	ST V		1		1	. /		1	ه د ا	21	<b> </b> 0	1:::	1:12	Į I		Í.
	6			]	(11.1)	1: 1		<b>∤</b> ∷		1		Ī	.0	1	1	-	-			- /	7	7		1		1/4	***	1	17:		1	i
12.	Ø :::		1		•	1011					<del>````</del>			<del>                                     </del>			جنب		<u>ا بــــــــــــــــــــــــــــــــــــ</u>	الرا	<u> </u>	٠	-:-	+	- 5	1/5	C <sub>p</sub>	<del></del>	<del> </del>			-
Y	أجينا		4.5	17.11		15.		.::-		:	<u> </u>			1	<u> </u>					II	1	. ::!		Ŀ	L .	<u> </u>		1:::	<u> </u>			Ŀ
XC-1				1 ::		l:			1::		72	ان ا	1:::			<b> :::</b>			/	1	1			-11		1	1		F.:			i
4	1					]				1	1		1	Ι		1	1111	***	7	<b>/</b> /	.;:-	*:::	::::	1:2.	1	1	1	11	1111	Ĭ		-
3			<del> </del>	<del>}</del> ===			-		-			ļ	-:::						/-/	- 41		7.8	1276	-33 1		11.17	ļ	٠			<u></u> -	1.
WHES KNYK	12.1			H									ļ	1		*:::		. 7	$Z_{i}$	7.	*		****	MF	<u>}                                    </u>	1::		1:::		::	111	Į.
6		11415	153	lissi		1			***	ii.	:::			1		:::	:::			.:::	:	A			19	<u> </u>	1		17:		T	
الما العالما	Î	1111		1. 2	i :	17.7	7.77					-		1				ř;	7			1	::::		70	5	<del>                                     </del>				<u></u>	-
M-1				<u>.                                    </u>		-			Ē						ļ			1	/			1	1	1	-	<u>: * </u>	ļ		j		1	1
2 2			::::.	<u> </u>		1:-					١:	<u> </u>	1:::	: . <u></u>			17			• • • • • • • • • • • • • • • • • • • •	:::	1::::			1	li.:;		1.	1	1		į
M.			<b>.</b>	1		1	_	1 3			: :	i : :			111.		17	1			:::		1	1	1	11.1	i		1			-
4	4	-	1	1	1	1				-				<u> </u>	+	· '	7.7		- Crust	juin	DUG.	<b></b> -		+:::	-		<del> </del>	<u> </u>	1	-	ţ	-
4.5.4			1	ļ		-	ļ <u>.</u>			<u> </u>						:;/	/!	-:-				17.	1:::	1		ļ		1	1	ļ	ļ	4.
			1:::				1::1-	;						l::::	L.,		<b>Z</b>			::::	-							J::.:				
}.\~`	1:15	31215	i iii	111.		150						:::	1	1	1/	7							117	1	1	1		1111	1	1		-
	Ţ	::   ::: :		1		1						جون ا			//·	J.,			*******						-	-		ļ	ļ.,	-		÷.
	5.4	11.1.11				1	==							1			1							1				1	<u> </u>	1:		
	1:: \$			ļ						:	::	l ::-	ļ.;"	36.00	1		[::.]	::::		)	****		•	ļ:: <u>;</u>		1::.	1. ::-	1::::	1	1-1	1.	1
			1	1		]:-	Γ.		٠	-		•	17	17	1	-			::::	i				Ţ	-	1		1:::	1	1::::	<b></b>	į.
		7	غنينا.	1		1	ļ						11	٠	¦	<u> </u>	إشتا	4			•	يننيدا			+	٠			-			<u>;                                    </u>
			1:::::	l		]:::	1	Lini	L_	<u> </u>		1	1.1		1.	1				:::	::::			1	1	<u>L.</u>		1				1
sicalia:	1			ŗ		<b> :</b>	( :::	1				$/\!/$	21.5	F .:		ii		1.1	!				ŀť:	1.1		]	: :	1: ::	1			í
		A STATE OF	1	J:		2	-		1		1		1			i bautin,								<del> </del>	-	7. salan 1. salan 1. s	1	****			•	+
1	1		4	144							13			,			<b>  </b>	إخنا			***			<del> </del>	ļ		ine .					1::
			1	Li.	1		liii					i Achiery	۱				أنسا	<u>:::</u> ,			::::	انتنا	<u>:::</u> :	1123	1::::	نازل					-	1,
	ļ <u>.</u>		1	1 4	1	1			ذ : إ	P. O. A.	1	!	13.5			j::::	l::::\	::::		.:::			<del>::</del> ::	1::	1:::	1.::						į.
					1::-	1	1 "	2	1	4	~	<u> </u>			]									j: :	1::::		1::	7.	111			-
عنظ المناث			+-		1	1	ļ-::	1	روم زیری		ļ	·	٠	-		! ! ! !				* 11				1.1	1	ļ				النبنية	<u> </u>	1
	1	.:: [:::	1		1	1::	1	24.4		land.			į		l			115	::::	::::	•	115	<u> </u>	1:	<u> </u>			L				1
			1		1	1	بموسي	[:.:		1.1.	1				<b>:</b> .			•	:::1	1111	<u> </u>	1			1	14		1.7				1
	1			٦	المعمر	1	1	1	1:::			-	1		٠٠٠٠	1	1			-					1	filli.	****		-	إجنسا	لببنيا	į-
			ļ.,,	مميرا	1	12:					ļ		1	ļ	ļ.										kä.						لننظ	Ľ
HEID:			*	1.:	1: ::	) - : : ;	ļ. ·					i	1:::	;·	1			,	ij <b>j</b>	-::	,4: ;		1:::	13			; ; ;	-41				j.
	1			بدنا	1		1100		****			1	10000	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			المشما	7	إبنان	-	*****	nant p	******	, minut				-				-
	(	<b>)</b>	1	1	<b>*</b> :-		سدا	1:			ļ		Ý.	·	ļ -::		7			14	7	111			<u>.</u>			تنسنا	احتنا			4
Charles & March		)	1	<u> </u>		ji.	ļ		ـــــ	!	-1		∤::::	Ì	ļ		3			انت						11.	1	SL	26	4	4	2.
erel serié discerci		, .		1.	E .	1. :.	1:30	1	15.1	0	-1	7~3	<b>.</b>	<u> </u>	71	EE.	h: .:},		~"		.:::	[::; <b>!</b>	: ; ; .	<b>!</b>	1		.:		. ;	. 1	, 1	1
		i	1	1.	1		1								16																	

慰

Commercial and the commercial control of the control of the commercial control of the commercial control of the control of the commercial control of the commercial control of

Page 73
Report Ho. A-Atlas-103
Date 15 Dec. 1954

	1111			1211	Ties:	i i	1	15		I T	12			1::::	71.12	13.3	27:21	P		==1	£:£'¥:		<u>-</u>	1	11.1				A .	<u> </u>	꾿	Do	0.	4
	::::: :::::			1		1					-	-	-		-															<u> </u>			2	
			1111	1		1	1:			-	1::	1				::=	===	-	335	15.	==					-	::::		. Ţ	1:12	-		112	::=
		115				1		15	Y	L	C	E A	Ŧ		۲ĸ	rii)	37	ΔŢ.	JR.	7	D) (			٨		4		F	1::		1111		::::	
				E			13			2	Ti.	فلعلن					-		A CALL						4			<del> </del>	-		<u></u>	1:::		-
					10.7	-			-	4		-	<del>ا :: ا</del>	1	ļ.Ŧ			==										1::::	1:		1			1: "
					Ľ:	ĿĿ				1::			[-	=	1 ¥	Δ	17				11:1			:::				1		j::	1 - :	<u> </u>		Ē
						4.5	.†::-		.: ::-			-1:	1.: :	i ii	i-,-i				115	=-1			9	::::	:i.;		1:11		1::-	1-:	1::2			
		•••		1			10.	1	1	7	4	-1:11	1:=	1:2		1117			11:0		10				:::1	-	::::	1	<del>                                     </del>	<del>                                     </del>	1	1::		į.
				- 3		3 43	42	42	- 5	7.			1 = 1	-	- :-	1	103	P.S	_ext		-								<u> </u>		1			
			-	1.1.	=		1	4 :		7	<u> </u>		133	1::::	ĽΞ	-	*: :	1.::				9		:		-	]:::	1						<u>!</u>
			-				1	:1:	17.	1			1.		1			I IF					-: 1	===		ä.				<b>j</b> :::		ļ. :	. :	<u>:</u> ::
			14		==						1::	JE.	1	1		I.L.	-	11.	7:5											1	1	Ţ: <b>-</b>		Ī.,
			-	Time		17.3		1:		<del>;;;;</del>	-	4	1	Ī.	rl::::	1. 7					11::1				<del>                                     </del>	<u> </u>	-	+	+			<del></del>	1 .	-
انتثثا				-	#	1				4:::	4		:   ::	1	1	##	<u> </u>		1==1	==		-	::::			1		1-	1	<u>;                                    </u>		·	-	Ļ.
		-1		1::::						١.	1:			7	. <u>]::.:</u>	17 -		::::			; : : <u>.</u> ;		. 1	i	::::	1				1.	]: :			!::
17:50					-				1112	Ŧ.;	11.	1	:	1		<u> </u>	::::	1:::			: ::	:=	1	j,				Ī			7-:	1.5	1: ::	1.
		7		1:::	1	-	: :::	ΞË		::::	#:	1	1	4		1::::	-	1							<b>::</b> ::	111	1:::	<b>†</b>	4	<del></del>	-		-	i
	}						127	4		1	1-	ᆁᆍ	<u></u> 6	ننإ	12	1::-:		11	- 1	===		-	::::			1:2:	1	٠	1:-	-		4:::		÷
1::,:			-17		Ţ		1	JE		1	-		J	1	1	<u> </u>		133	155	-:/	:::"	إن	11.53	. : : :		1: ::	: :	[:::	1	L.	11	<u>: :_</u>	<u>r.</u>	L
		11.		133		1.5	:[4	.]-		: ==			1	1:	1	ļ.,i.	T.	ti:		:T				1:::		1:1:	1	-		1	.[:	1:::	ļ: .	1
				1	1		7	†	-	+	1		-	<u> </u>	1					T			=	T.::	t.		1:50	1	† ·	1	+		1	÷
		==	111	Ľ	1	#=	:}:-	-		-	+		41	17	+:::	1:::	ſ÷÷	۳		<i>[</i> ::::	H			! • ! • . ! : !	-		<del> </del>	۱.,			-		<del> </del>	+
1		411		11.	1		J. F.		11.	111				7	1	1		1:-1		-11	:1-:				-		:		1	1_	26)	بنني	-	
			11.		1				<u>.</u>				14:	7=						735		2		<u>.</u>	<b>.</b> :		1: :				$\overline{1}$ :		1::	;
		1	ii e		1	1.5	-1-1			1.		7	13	F			3		I		141				1		1			1	1		i	1
					1:	-	-				+	1	+	=	<del> </del>	+===	-		1					<b> </b>	i	-	1	Η-	-}	+-	+		<del> </del>	÷
Tree		· = ,		4			1:			1:	4		1/	1	1		:		1	::::		::::		=:	1:::	1			. .:	4: -		. <b>!</b> "	ļ:	نذ
		,					4				:17		7		-1	1: :	1-13								<b>.</b> ::				:::-	١,	9	,	. :	į
	· · · · !	, W.				-1	.1::		: 11		7		A.				1.::	T:-	111	::12	3.						1		1	1		!	1	ĩ
1111111		) <u>(                                   </u>			1::-	37		-1-	+	-	<b>1</b> :-	++->	1::1	1 1	1		7	††	-	<del>:::</del>		<del>:::</del> :	===	1:::	1	1	1	<del>: </del> -	+	1-	: -:-		1: =	t
					1	12	ننإة			1:1				+-	-		1	-/-	1			::::			-	-	-		1-	1-	+		<b> </b>	÷
			(in			+;			3	1/		://:		1::			1	1	ļ;	7			; ; ;	!:::			i	13	1::	J:::	1.	<u>.</u> :	1:	j.
78	1		γ	1	Ţ.: *	1	7 1			·	30	: [::	: ::		1	7::	:	1		7	::::				-				1.	1			1	į.
1111	1	-1-		+	1:::	11:		-		7	-	<i>f</i>		<b>!::</b>	1 11					rii,			141							استرت	4	• •	-	Ť
C		1::4:	¥::::		1::::				- 4	-				1		1				-7	1			1	+=	-	-	+-4		Į			Ļ	
- M			í	1: :		1::			1/				1:-:	1	: :::				1	./:	1:::	1:1		1:10	1		1:	<u>.].:</u>	Ŀ	1.			ننا	1
		·	1:5	1	Ţ.,	.]::			<b>y</b>		Į.	1					V		ļ. ::-	<b>/-</b> ::			***			ili	1.1	: :.:	1	<u>.</u>		. 4	1.	:
Chi.	l 	نڌنہ إ	1		1				70		7		~		1:::			1		177		-		i	1		1	1	Ť.,	1		· -		
	įĘ,	199	1		Ų.	33.7	فنإع	Ž.,	71	1.7		ANIE	РХ.			+.,			/-	تننب				بنا	ļ		ļ.,	1.		4-1	٠Z.	- L	77	,
College	1			j.::	1-1	<u>H</u>		-	f: : :	1.	7	: <b>:</b> :	1.:	.1	di.	1.		1: ::	12				1157	1						1_	1		1	ì
	Ĭ		-	:1.::	1				. : :	1	١,	.: ::	, 1:::	: :::		17	1.7	1:1	<b>/</b> ::			112		1:::	1 ::	. نما:	1:	-		1 ::	, <u>]</u> .	io	ر ا	
**** And Adv **			ļ	-	1			-		/	-	-	-			-		i leate	7		1			-		1	1.	-	-	1	i	i i		-
		-	ļ:	4.4	1	: :-	-	<b>}</b>						44.	. 2	<b>f</b> = -	-	-	milian	===		Xe	-		ببنا	4.	Į.,	4	+:	.ļ			· .	÷
:::::::::::::::::::::::::::::::::::::	1.	ξģ.	Ĭ	4:	1:::		-1/			.!. 	1	1	1.	<u>: i : :</u>	ب ا	6		1		ا ثا		1.1				•	7	Ϊ.	IJĹ.	L	15.		Ĺ	<u>:</u>
	1		į	.[		:1::	1	. ::	1	.1.	٠Į.,	1::		٠. ز		.j:		1		::	2::	11:		ļ. '	1	ii -:	Τ.	· .	ļ.,	. [	1		ı	•
<1.	i		Ý.			T.	7	7	1	1	. 1	10.	1		17	7	1::	7	1						1			1.		1	`.i`.'			,
	ļ	بين لم	ş		:	-1-/	4	ولب	<b>/_ </b> }-			.:: <b>.†</b> 0	r i Cil	i eti	TH:				+		-	••••		٠	-	+	-	-		4			+	٠
	Ŀ.		<b>.</b>					.L			<u>.</u> į .	. الداد			7	1	1/-	1		L	1						1	1	<u></u>	<u>.Ļ.</u>	4::		ļ	÷
. ::::	1.0	<u>g</u>		·: :::::		Ä:.	. I.,	<b>/</b> .l.	::: <b>:</b> }•.	ijς.		· †:	:	11.	1	i i	¥::	i ki	ı xer		1::			1.		1	Ŀ		1		-		1	:
		7	1	· í: ".		Ý.	7			1	Ī			11:7	7.]	1	λ.	J	1	:: .		::::		100	1	1122	Т		1		7	1	1	1
		1			-1.7	-	7.				7			-17	`:}-:	4:1	بمسلم			<del></del>				-	٠,	مبنب	- <del> -</del> -	-	-†	-			<b>.</b>	-
	1:1	. ; ; ; ; -, ; ; ; .	į		. X		<i>(</i> )	_!_			1		٠,		4	ــــــــــــــــــــــــــــــــــــــ	+	<u>.</u>	+		j		٠	<u>.</u>	ļ				٠.	#:	<u> </u>	-11	ļ	Ļ
·			<b>)</b> .:	3:.	Λ.	أوار	· J	. ;		1	J	1		1	Ŀ	Ľ.		ji.						1:	1	ij	1.	1	1.	L	1.	.i	J	،
1	Γ.	Ţ.,,,		1		1	. 1	ī	Ī		1		1.1	ĮF.	.:	<i>[</i> :	100	1			ji:		( : .	}	1.	1		1	·[		ا اور		1.	;
	1 -	<i>(</i> :::		1	1	a.	-;{:-	÷	1		4		17	÷	11	4-4	-	+			1	نار جو ا در المراجعة	T :	-	1	1	1		+	17	***		-	÷
	<u>;                                    </u>		1	f		:4:					:4:	: 1: ::::::::::::::::::::::::::::::::::	1/.	.,	· i/.		نيا }	4.			Jan.		} :	<b>.</b>	4	¥	4-		f	4.	-	4		i
1	1.:			()	p			1		, .	1		Ľ	بنازر	.53			1			1. · ·		<u> </u>		1-	J	1	·			1		1	J
• • •	7	7.5	1/		1		::[:				T		1	1	<b>}</b> [.!]	1	1		1		1			1.	1	1.		1		T:	T		!	•
	-j		7-	17	-	-(:		::		ماردند ا	:+	-: i	$H^{*}$	17	-	<u>.</u>		مدالج	Ţ:	·	r :			1	1	Ë	1	-!`.,	17:		~[**	·4-···	·	:
		ξŧ	- 1	-	4	-,4-1		-4		4.	Į.			45.	rafaa	-non pr		4	أبيه أباء	,	<b>.</b>			+	+	-	٠ <u></u> ٠٠.	<u>-                                    </u>	4	4	9		٠	Ť
	1		1	i,			1 7	:İ	: <b>.j</b> .	ii.	1.5		-	غمال			٠, ١	انتان	炒		$\perp$		ļ.	1	J		.   .		ļ	<u>. j</u>	.j		ļ.,	
	1		1		1:	1.	77			, !	1	$\mathbb{H}_{i}$	1	1		1	1.			•	1.		}	į	j.	10	İ		Ì,	ì	1	$\dot{T}$	i	•
			<i>;</i> ;		"			· · · · · ·	j .	دد این اهرا	- 4	ΩĽ.	Factory of	 	1	, , ,	Ì	6.14		2 7	12.3	11.00	~ "	1		najiraja i 	100	· · · ·	٠,٠٠٠	31.74.6 31.74.6	۔۔۔ حراج	·60°	٠,٠,٠	;
				*	1		. 1		•	· •	- 1 :	/L	10.	4.		1	1.5	J2 4	1 5"	21	П				Ъ.,		1		160.	47 K	-	404	3	٠

40

A DESCRIPTION OF THE CONTRACT

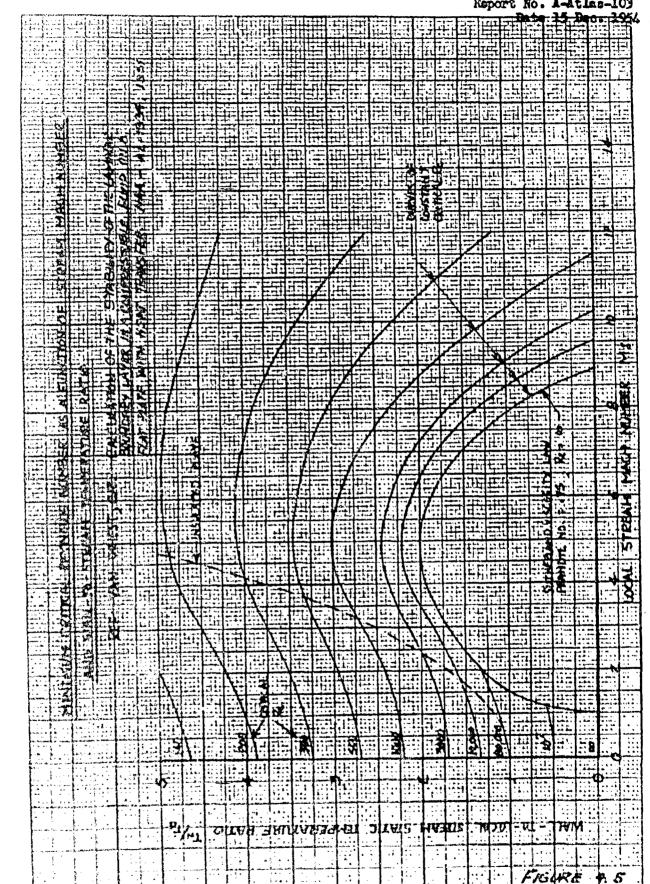
Page 74 Report Ho. A-Atlas-103 Date 15 Dec. 1954

			·			·					_															-	1	Dat	-/0	14	The	ø.	-1.U	
			<u></u>		:::	7:::		1			1	1-1	F.F.		=1			10.		45	144		111.	1111	1:2.	1.11	15.71	-	70		8,040	*30	-	אַכי
			<u>:</u> .					IN	i k			+	Tre	1		33 A		3.5	Di					1	-	!	-	1:-	-	٠::	<u> </u>		2	ļ.,
		H.E.		15.			15		بنناء	بهزامه		1			MI		14	3	11:	-	****	d.	4-	<u> </u>	-		-		ļ		<u> </u>		1:==	1
					<b>***</b>			Z	1	1:::	i cy	1		ļ	1::		+			-		: : '			li.		<u> L.</u>	1	-	<u> </u>	<u> </u>	-		
			1		- 7		J.c		124	1	Æ,	1	+		1::	-	ماما	M	hi			ø.							1	<u>                                     </u>	ļ: .			
		· [	122	1.5	1:::		115	E			3	150		1		<u> </u>	]::::	į .	.::	:::	:::	L J	. 5	<b>.</b> ::	: :		-	1::	T:	1				1
			: -1	1			1			ļi	1:2:							i E	2				Œ			1		ī					-	:
		<b>;</b> ;;;;		E:E	17	i::n	11	# .		1	1		1	11.1	1	1		[F,j]			111					1.7	6-	+	1:::	-		1		ښن
		-	48	1		1.1	13		1	1.71	U.	1	ΕΞ			F.	<del>                                     </del>	1::1:	1	1	-	727					-	-	-					-
		1	-11	1	===	-	1	1	1	1	1	17.	-		i.	ř.,	}		#	1111	===		<u>::</u>	<u> </u>					_					Ŀ
		1			10.1	<u>h:</u> 1.	<u> </u>		16-		<u>                                     </u>	1		Ш		L			1.:	1					<u>  : : :</u>			1	1::-	Ŀ.			j.:.	
نياب			EE	ĽË	ir E	1:1:	12.12	1:5	/	• •	14.3		1					i, i	ĮĖ.	1			.1:							1		į: :	].	
AL.		1		1	; t	1:::	2.	Ti.		ł ; .		111		Ti.		, , , ;	1	1	111		:::	ï:	::::	11:2	1			1	1	<del>!</del>	1			i
1	117	1	īï.	1315	:.1	1:5	]:=	1		1	17	ļ		- 1	1	12.			T.			===	12.1	1117	<del>       </del>	-	<b>-</b>		-	<del>!</del>	<b></b> -		-	-
	+::+	7.53			211	1	12	+	<del>}</del>	<del> </del>	11		-	-	ļ.						::		::::	Ξ-	131	ļ.::	ļ.,	<u></u>	<u> </u>	١٠,	<u>.                                    </u>		<u> </u>	1
1	4.		1115		1		17.	11.	1::	-	1	Į			1								:::	<u> </u>	1:1:		<u>.</u>	i.:			ا: ا		l :	
i i je je	i i	验当	1			1	100	1	1::	<u> </u>	<b>/</b> .:	1		:11	Ţ.,		21	L	Ψ.	-	a-				[:::			1:::	ļ.:::	<u> </u>	ļ: , ·			
1	115	713			1::	333	ļ	¥ ::	1	:. 1	( ::	1	1	ı.F	<u>.</u>		1	<i>T</i>	1.1	1111	賠		<b>!-</b> ;.	- 12	1:1	T	1	1	ĵ.:.:	1	Ī.,			-
1,11,	1:1	ij.e.i		::::	111.	Į:	ļ	1	155	;;;]	١		1			<u> </u>	1	<b>!</b>	7.11			**	••••	i: Š	-		<del> </del>	Ť:	i-	;:::::::::::::::::::::::::::::::::::::	<u> </u>		<del> -</del> -	-
1	#=				1254   117	<del> </del>			13.2	$\dashv$	1	14:	111	-		<u> </u>	ļ,							<u> </u>	<u> </u>	<b>!</b>	ļ	1	1		<u> </u>		ļ	-
-	-		ا: ا			1:2:	<u>::</u> J:		1:-	: [-		۰	نتا	¥			<u> :::i/</u>	1				333	. <del></del> .		15.	<u> </u>	1	1		Ĺ:				
	وتنار		:::		1		U	i:r.	<u>                                     </u>	T:	! !!	<u> -</u> !"	1:::	ĿÆ	<u>.:!!</u>		时			::=	ī.	H	H. 1	ļ:	<b> </b> :::	1	3	ļ.:::	1:	ļ,	[ '::	į .ii	ļ. ::	[
		]:";		1			7	::::	1	1		i i z	===	Į.		HE	Ŧ			11			1	1.7		123		ļ	1		ì	1		
	15:	11.5	f. L.		. 11:	1,512	¥	1		111	1::		.::	H.			7	33		: 5		i	7.3				<del>                                      </del>	-	-	-	ļ			-
		-	-11	1111	ı;		-	<del></del>	+f	ļ.:::	<del>                                     </del>	1111		-			-	-	1111						-		1	ļ	ļ	L	<u></u>	-		خإ
		-			32	1	= :	=	17	<u> </u>			1115	etr.	::		d:				Ш	Ξ.	1.;			<u>.</u>					14.			烂
	1.		-31		200	1		1::-	1	<u> </u>	150	ارزا	iri	:::				1			ກີຕຸ				ŀ	Ε.		i		ļ. '		: •	. ::!	<u>.                                    </u>
		1::12	Ŀ.,	!: i:		Ų.	111	Ė	) : L			,		1111		1	2.1	1		1			1					1::::			1:			F.
	15			.7.5		7	33	1:7		1: -			7	::::	11:	1	111			==:			1:1:				1:::		-	<u>.</u>			Ξ.	j-
+	1		= .		:::	G I	11.	1	1	<del> </del>	-	(	1			3:	==	٠				1		1		1:::	1		<u> </u>	<del></del>	-			
-5-		14-TU			-	ı.i.		-/-	<del> </del>	<u> </u>			-		111	-	==	<u> </u>	==				==	1111	=	=	14	-	1				3:	<u>.</u>
		2	: : : :	1117	11	122		1/2	12.	[Pier	1			-11			-	<u> </u>		. :	:::1		Œ		1:::		ij.	1			Ĺ			<u> </u>
7		2	<del>;;;</del> ;		: [-	1:::			151				1	##			1	1		믜		追	<u>.</u>	11:		11.11	l = .	1:5	1	•••				
4			Ξ		1.		1	r - r : : :	1	:::	:::	1	117				712			1		F	in				d.	١	a	<b>T.</b>	•			
		1					1	71112	ī			7	7			-	***						701	=			-	1:	i.a.	•				
X Ch	1					-	1		1::-		-	1			1	-[]-		-					==	:::			٠						٠	
	100		44		10.	1:12	4		111		-11	1	<u> </u>		Ι.	-					3	$\equiv$	Ш		:::		Ø.	1	èE	×.	٥	3		
(2)				1	31	i.		<u>  :::</u>	J	1111												. Ē.			1		<u> </u>	:		l:	•	!::::		Į:;;
	1: :	1		1			=	i:::	<b>:::</b>	¥::					•			,				113			i .		12	1	1:-					
			: 1			y.		1112		:::	1			. 7		+	15.5	11:5	411			15:1	:::		15.	:121					-		•	· · ·
31-		1			12.	7			-	i - : :	1	1	7	+			-				-	==			-:	<u> </u>	1		-	• • •				
rel de	3	0	<i>: .</i> !				L	##X	D.		4		-	J:	1	N.	AA.	:		= 1		-:	:::	:::	1	-8	9	-					لندا	<u> </u>
4.17	j	1	i.		:::	م		<u>[:::'</u>	ļ. <u> </u>		1	٠			90		نندن			ш	ш		::::		٠	L::	ن∷ا	Ŀ	<u>.                                    </u>		L.,			j :
	]:	<u> </u>			1						ř			[.				[-		41.		<u>:::</u>		:	::::			ļ	-			• 1		13
1.1:-	-			: 7		:=;	T	Ī.	1::	1.	:		.::	::::								=	<u></u>					<u> </u>	Γ				•	
		1, 1			1		<u> </u>	1	1	]		1:11		7		11:	11.	1	1				=:			Ħ		1	<b>†</b> : :				<u></u> با	
	4	1					1		****	情		٠				::::	٠٠٠٠	-		∹┪		쁢			ш	-7	Ð.	<del> </del>			::		<u> </u>	ن خیا
نسنوت	-			/	•			1	1	÷F:	} ===	-	1		1	4		<u>                                     </u>	إننا	انية	أننت	쁴	415					<u>(: : :</u>	<u> </u>	•	1	- 1		<u>.</u>
	.1		، . ـ ـ ـ . ا	_[]	:::	:::		ļ :	1::	11:			1	-:::		:::		<u> </u>		:::	:::		<u>.:.i</u>		1		Ŀ		İ., .					
1		*		1	12	÷			<u>j</u>	, i		<u>.</u> .	<b>y</b> ]			::	:			.:: [	]		:	111	::::		1	<u> </u>			•			
į		1.1	. 1	7			1	1	- :		Γ.					;:	ļ	1	1.1.1	: 1	<u> </u>				7		7	مسف				:	:	
بدمعمان	1	4			.~ <u>.</u> .÷			-	177			Ť			الندر		ᡟ÷				انت	***		÷.:			7-			:		;; ; <u>;</u>	!	
	- :::	7.7.4	3	- :-	رندا).	-		ļ; <del>.</del>	1.7	<b> </b>		·/:	إنجنوا	:-	وبذ		<u></u>						÷i				<b> -</b> :			]	ايز			٠.٠.
			÷ [:.					į	1	11		1_									쁘	انت	ان:	181		بننا		<u>.                                    </u>					• ;	,
	3		1						j.	1		1	7					::,	7	انن			::1	` ;}	.:			]	. 1				:	
	1		7::				1.5	ļ	ii.		1	[		• • • •				11.1		7.1										- 1	····Ì		kara é,	
	-i - i		بإست				تدبد	brodd L	Leve	Jugal.	****	*	***	٠٠٠				144		ابت			ا::ز			۲.,2	-				إسن		r. sun	
	1	10	7		yn	2	/2 <sub>-7</sub>		\-!- <u>-</u> -	7	2		ىن		4			2	8		11.	-3	•	4		-			ļ <sub>i</sub>		ه 4ء - ده			** •
	1	1	ا ، ده بد			ļ		1.3	1			******						أنبينا	أساي		:!	ا: ا						E	Œ	AR.	: 4	4	G.	
	_	٠ ا	. 1	١٠.	1-1-	į ·	į. !	12	17	00	12	١.	FI	18	أذعا			h):"	5	• •			[		•				]	- (		Í		
	1							2 -			A 2	ž	18 F	.,	7		4.1	M	1										ıFS					

100

CONTRACTOR ABSTRACTS DISTREE

LOS STORES THE ESTRONOMENT OF FORE



CONSTRUCT & COTTOCK CONTROL TO TREE Exterior and Tree Control To Control Control Tree Control

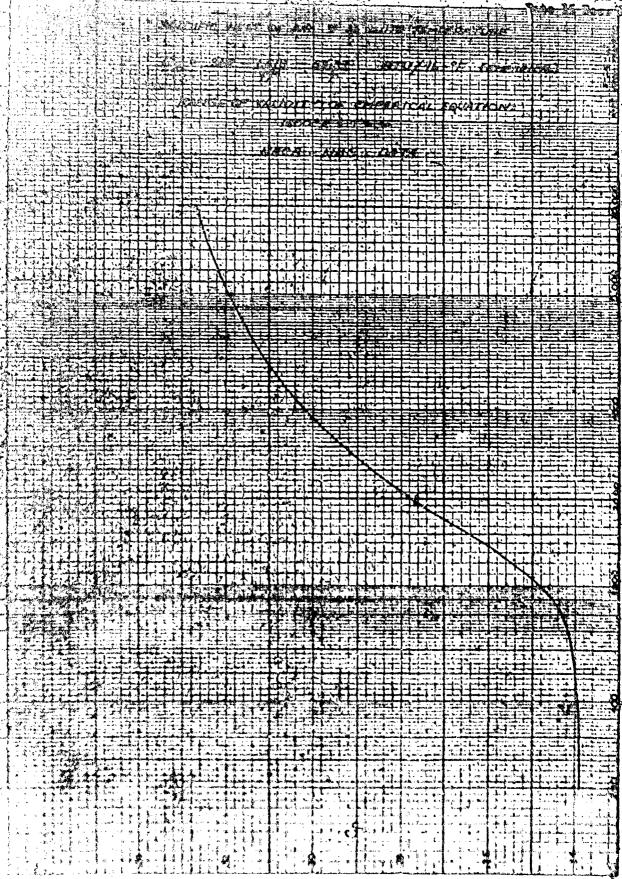
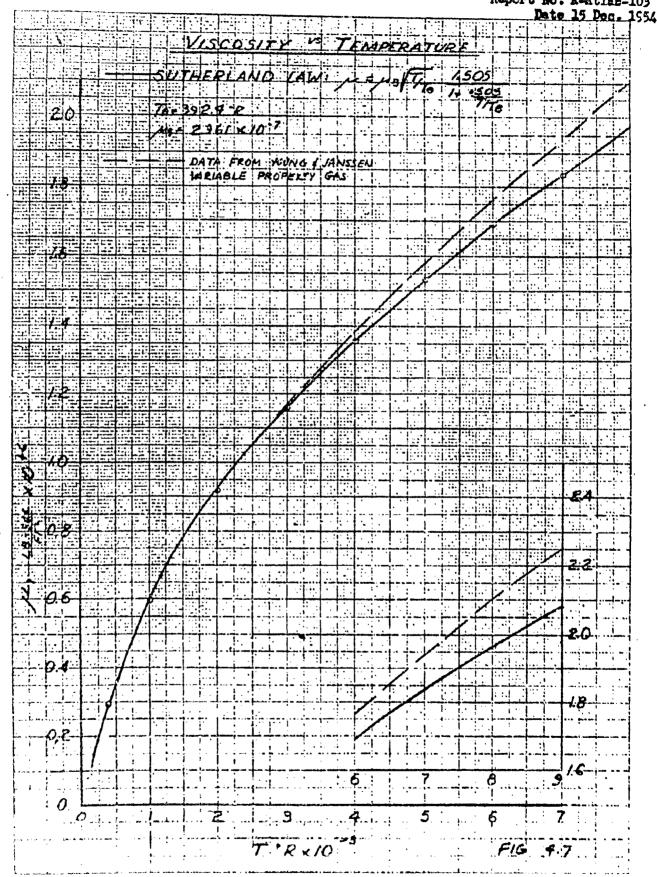


FIGURE 4.6



A. LOTO THE CH. . INDIANT OF OF A

;: .~